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VERIFICATION SAMPLING AND ANALYSIS PLAN FOR SITE 8 HERBICICE ORANGE STORAGE AREA AND OFF-BASE AREA OF CONTAMINATION NCBC GULFPORT MS
12/1/2004
TETRA TECH

Verification Sampling and Analysis Plan
for
Site 8 – Herbicide Orange Storage Area
and
Off-Base Area of Contamination

Naval Construction Battalion Center
Gulfport, Mississippi

Southern Division
Naval Facilities Engineering Command

Contract Number N62467-94-D-0888
Contract Task Order 0272

December 2004

060304/P

VERIFICATION SAMPLING AND ANALYSIS PLAN
FOR
SITE 8 – HERBICIDE ORANGE STORAGE AREA
AND
OFF-BASE AREA OF CONTAMINATION

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, SC 29406

Submitted by:
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661 Andersen Drive
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0272

DECEMBER 2004

PREPARED UNDER THE SUPERVISION OF:	APPROVED FOR SUBMITTAL BY:
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ACRONYM LIST

2,4-D	2,4-dichlorophenoxyacetic acid
2,4,5-T	2,4,5-trichlorophenoxyacetic acid
AOC	area of contamination
bgs	below ground surface
CCI	CH2M Hill Constructors, Inc.
CLEAN	Comprehensive Long-Term Environmental Action Navy
CTO	Contract Task Order
DEQ	Department of Environmental Quality
DI	deionized
DPT	direct push technology
EISOPQAM	Environmental Investigation Standard Operating Procedures and Quality Assurance Manual
FOL	field operations leader
FFS	Focused Feasibility Study
HASP	Health and Safety Plan
HO	herbicide orange
IDW	investigaton-derived waste
µg/kg	microgam(s) per kilogram
MCL	maximum contaminant level
MDEQ	Mississippi Department of Environmental Quality
MS/MSD	matrix spike/matrix spike duplicate
NCBC	Naval Construction Battalion Center
NTU	nephelometric turbidity units
ng/kg	nanograms per kilogram
pg/L	picogram per liter
PRG	preliminary remediation goal
PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RGO	Remedial Goal Option
SUs	standard units
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEQ	toxicity equivalents (of TCDD)
TRG	target remediation goal (MDEQ's)

TtNUS	Tetra Tech NUS, Inc.
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
VSAP	Verification Sampling and Analysis Plan
yd^3	cubic yards

1.0 INTRODUCTION

1.1 SCOPE AND PURPOSE

This Verification Sampling and Analysis Plan (VSAP) was prepared under Contract Task Order (CTO) 0272 under Comprehensive Long-Term Environmental Action Navy (CLEAN) Contract Number N62467 94-D-0888. Under this CTO, Tetra Tech NUS, Inc. (TtNUS) is performing engineering and design services for the remedial action (RA) at Site 8 - Herbicide Orange Storage Area (Site 8) and contiguous on-base drainage channels at the Naval Construction Battalion Center (NCBC or "base") and at the associated off-base Area of Contamination (AOC) in Gulfport, Mississippi.

During the upcoming RA, dioxin-contaminated media from areas impacted by the past storage of herbicide orange (HO) at Site 8 will be excavated, blended, stabilized, and consolidated/landfilled at Site 8. A protective cap will be placed over the stabilized material. The overall purpose of verification sampling activities is to confirm that remedial objectives for the RA are sufficiently achieved. This VSAP:

- Presents the plan to confirm that dioxin-contaminated sediments excavated from the on-base drainage channels within and contiguous to Site 8 and from the off-base AOC located north of the base are successfully removed to levels less than the dioxin preliminary remediation goal (PRG) of 38.2 nanograms per kilograms (ng/kg).

- Presents the plan to verify that on-base and off-base groundwater does not contain dioxin concentrations greater than the PRG of 30 pg/L.

- Outlines the plan to verify that the subgrade of the materials handling pad (if used) does not contain dioxin concentrations greater than 38.2 ng/kg.

- Presents quality assurance/quality control (QA/QC) procedures for field activities.

1.2 VSAP ORGANIZATION

The following highlights the information contained in each section of this VSAP:

- Section 1.0 – Outlines the scope and purpose of the VSAP.
- Section 2.0 – Provides site background and history.
- Section 3.0 – Outlines the remedial objectives for verification sampling and the sampling approach for achieving the remedial objectives.

- Section 4.0 – Details the field procedures to be followed during VSAP activities.
- Section 5.0 – Outlines the analytical program for VSAP activities.
- Section 6.0 – Outlines the data management plan for VSAP activities.
- Appendix A – Provides supporting information for the sampling approach and activities.
- Appendix B – Presents the Health and Safety Plan (HASP) for use during field activities.
- Appendix C – Outlines the Quality Assurance Project Plan (QAPP).

2.0 SITE BACKGROUND AND HISTORY

NCBC Gulfport is located in the southeastern corner of Mississippi, approximately 2 miles north of the Gulf of Mexico. The base is located in the western part of the city of Gulfport in Harrison County. Figure 2-1 shows the location of the base in relation to the City of Gulfport and the Gulf of Mexico. The off-base AOC is located north of NCBC, across 28th Street near Outfall 3. The base occupies 1,100 acres with an average elevation of approximately 30 feet above sea level. An installation map of NCBC Gulfport is provided as Figure 2-2.

From 1968 through 1977, approximately 31 acres of the base, now known as Site 8, were used for the storage and handling of approximately 850,000 gallons of HO in 55-gallon drums. HO is a herbicide formulation used during the Vietnam War to defoliate trees and shrubbery. It is an equal mixture of two agricultural herbicides [2,4-dichlorophenoxyacetic acid (2,4-D) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T)] in diesel fuel or jet fuel. HO is also known as "Agent Orange," a code name for the orange band that was used to mark the drums used to store the herbicide mixture. Spills and leaks of HO occurred within Site 8, contaminating the surface soil and sediment with 2,4,5-T and 2,4-D and byproduct contaminants (dioxins and furans), primarily 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). Concentrations of 2,4,5-T and 2,4-D have degraded over time; however, dioxin and furan concentrations have remained at unacceptable levels. Throughout this report, TCDD and its chemically related dioxin and furan congeners will be collectively referred to as “dioxins.”

As shown on Figure 2-2, Site 8 was divided into three areas (Areas A, B, and C), based on the level of storage and handling of HO. Site 8, Areas B and C (hereinafter Sites 8B and 8C) were periodically used as overflow storage areas while Site 8, Area A (hereinafter Site 8A) was continually in use. Between 1985 and 1987, the soil at Site 8 was remediated to the then current United States Environmental Protection Agency (USEPA) criterion of 1.0 microgram per kilogram (µg/kg). The excavated soil was incinerated and the ash was placed on Site 8A; however, the investigation and remediation did not include the drainage systems carrying surface water and sediment from the site into lower reaches of the local drainage basins (Figures 2-3 and 2-4). Due to dioxin’s high affinity for soil, dioxin migration has primarily occurred through repeated erosion, transportation, and depositional cycles within the on-base drainage channel system and to the off-base AOC. These actions resulted in the contamination of nearly 5 miles of on-base drainage channels and associated off-base swampland drainage channels.

The Navy has begun to excavate portions of the on-base and off-base drainage channels affected by HO storage at the NCBC. In November and December 2001, approximately 1,000 cubic yards (yd^3) of dioxin-contaminated sediment were excavated from the H.A. Edwards (Edwards) property located north of the NCBC as shown in Figure 2-4 (TtNUS, 2002). Additionally, in August 2002, the Navy performed a sediment removal action within the drainage channels of Sites 8B and 8C. Approximately 2,600 yd^3 of sediment were excavated in the areas shown on Figure 2-3 (CCI, 2003). Verification sampling has been performed for these areas; consequently, these areas will not be covered under this VSAP.

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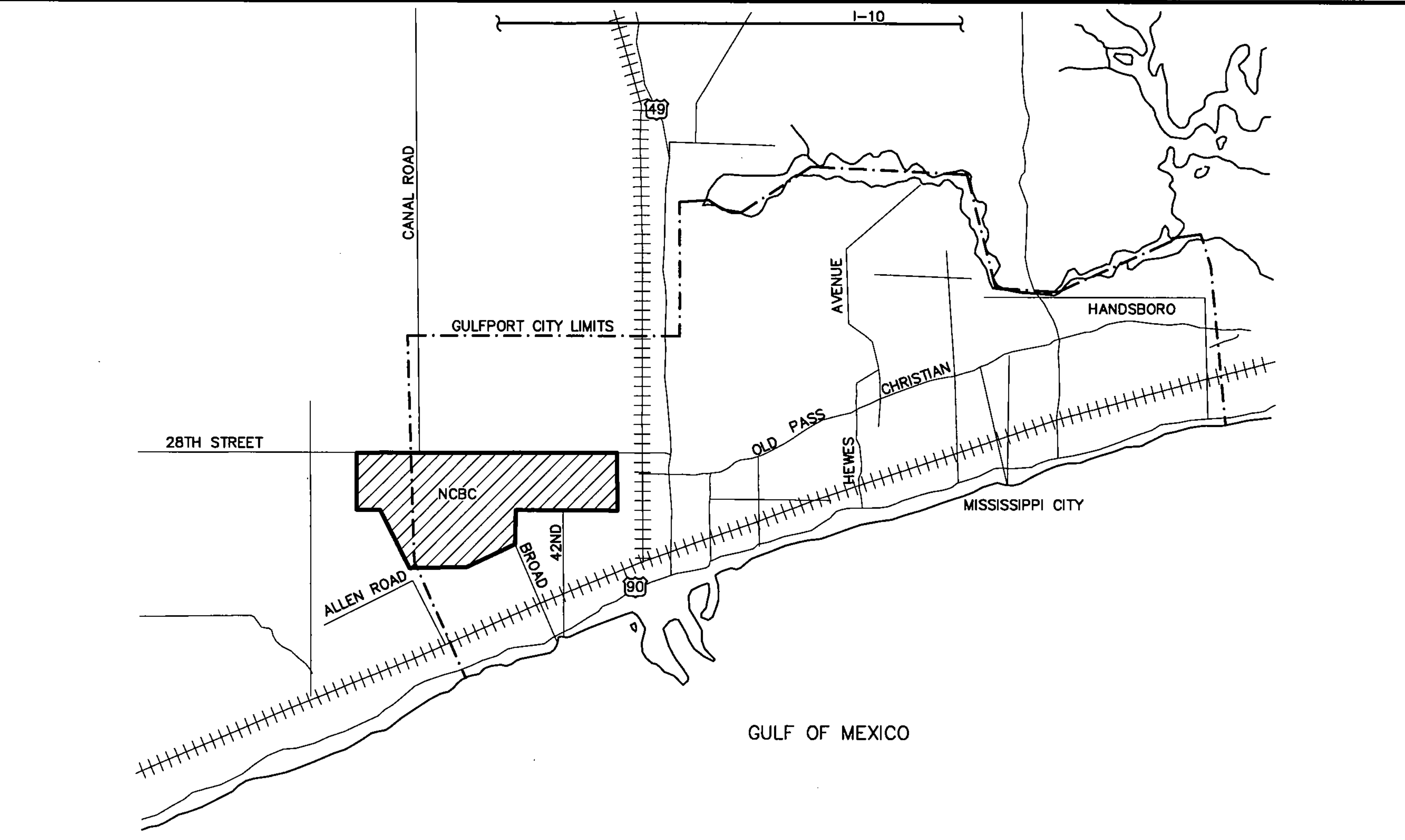

DRAWN BY HJB DATE 6/3/03		VICINITY MAP SITE 8 VERIFICATION SAMPLING AND ANALYSIS PLAN NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI	CONTRACT NO. 0567
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COST/SCHED-AREA			APPROVED BY DATE
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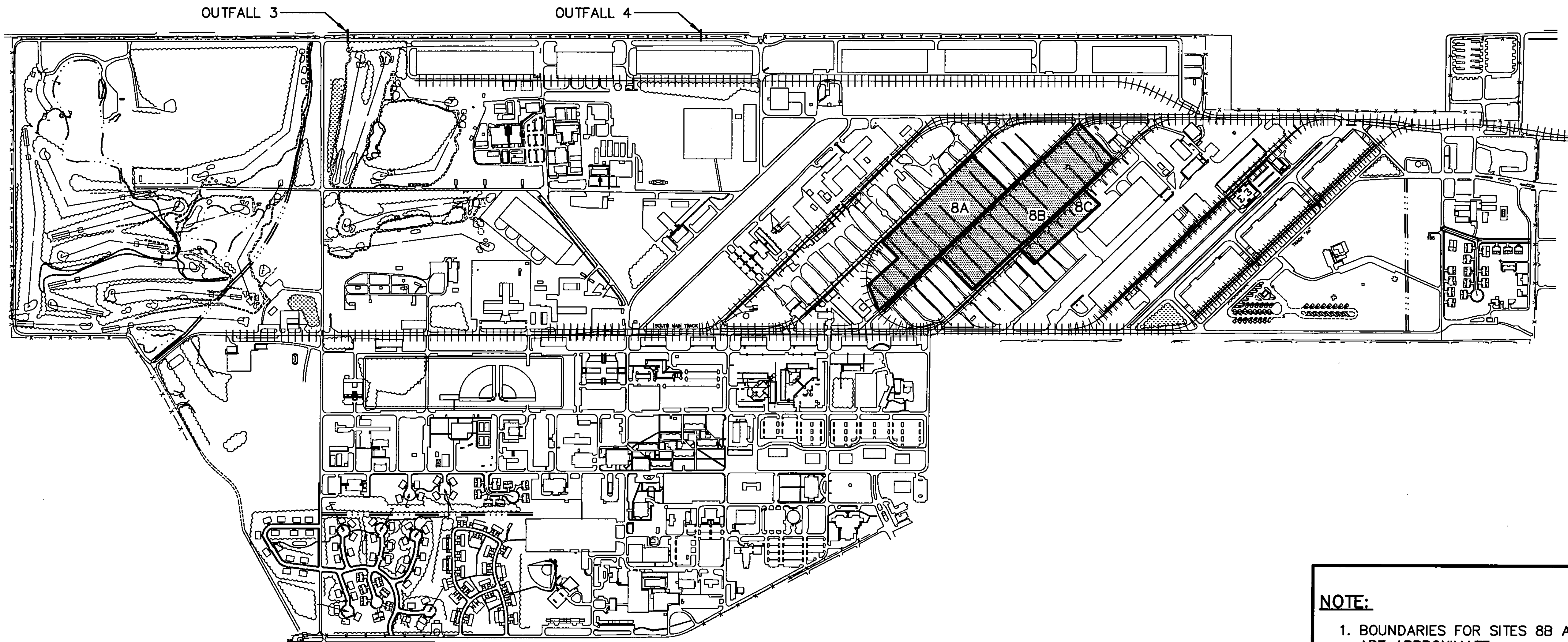

NOTE:

1. BOUNDARIES FOR SITES 8B AND 8C ARE APPROXIMATE.

0 1000 2000
SCALE IN FEET

SOURCE: BASEMAP.DWG, PUBLIC WORKS DEPARTMENT, NAVAL CONSTRUCTION BATTALION CENTER, GULFPORT, MS, JUNE 2001

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INSTALLATION MAP
SITE 8 VERIFICATION SAMPLING AND ANALYSIS PLAN
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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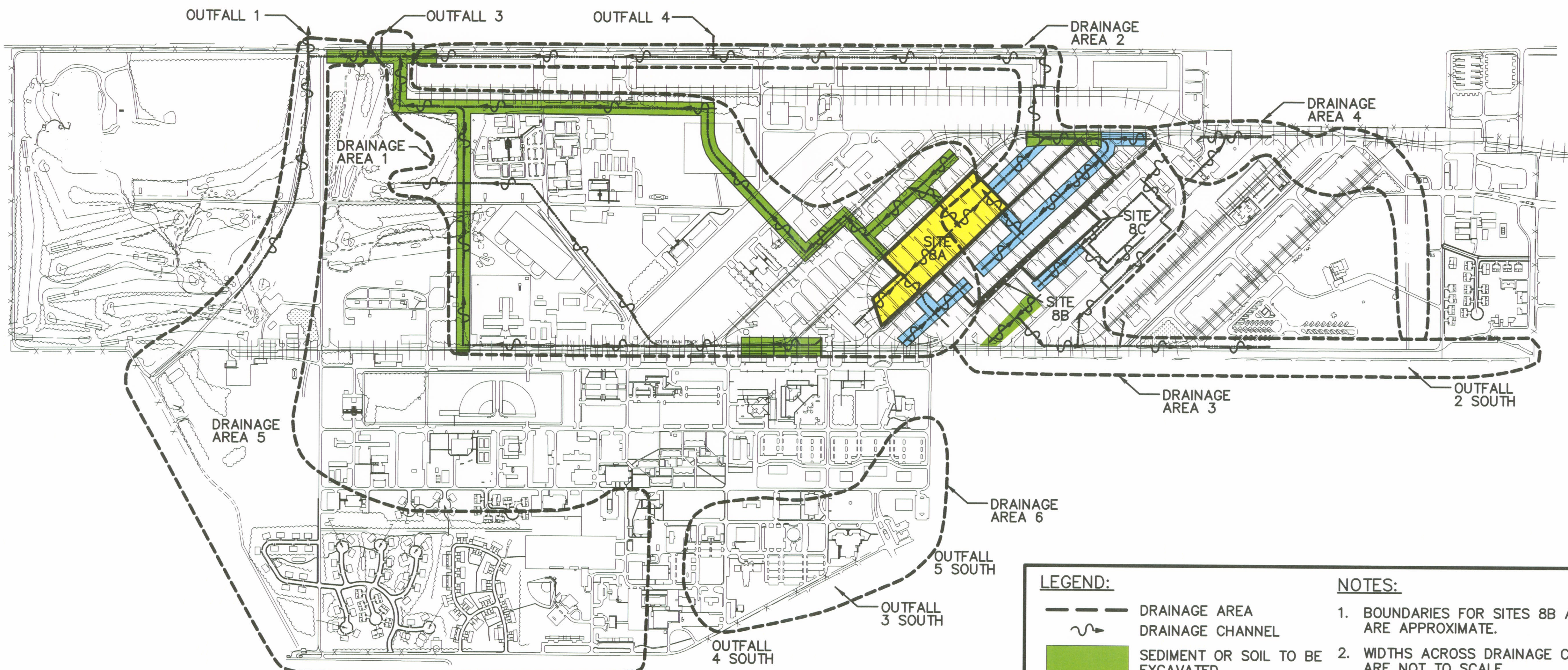

LEGEND:

- DRAINAGE AREA
- DRAINAGE CHANNEL
- SEDIMENT OR SOIL TO BE EXCAVATED.
- BOUNDARY OF CAP (SITE 8A)
- SEDIMENT OR SOIL EXCAVATED (CCI, 2003)

NOTES:

1. BOUNDARIES FOR SITES 8B AND 8C ARE APPROXIMATE.
2. WIDTHS ACROSS DRAINAGE CHANNELS ARE NOT TO SCALE.
3. SEDIMENTS IN SITE 8A DRAINAGE CHANNELS WILL ALSO BE EXCAVATED FOR STABILIZATION PURPOSES.

0 1000 2000
SCALE IN FEET

SOURCE: REMEDIATION PLANNING DOCUMENT, HARDING LAWSON ASSOCIATES, AUGUST 2000

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

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AREAL EXTENT OF ON-BASE CONTAMINATED MEDIA
VERIFICATION SAMPLING AND ANALYSIS PLAN
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

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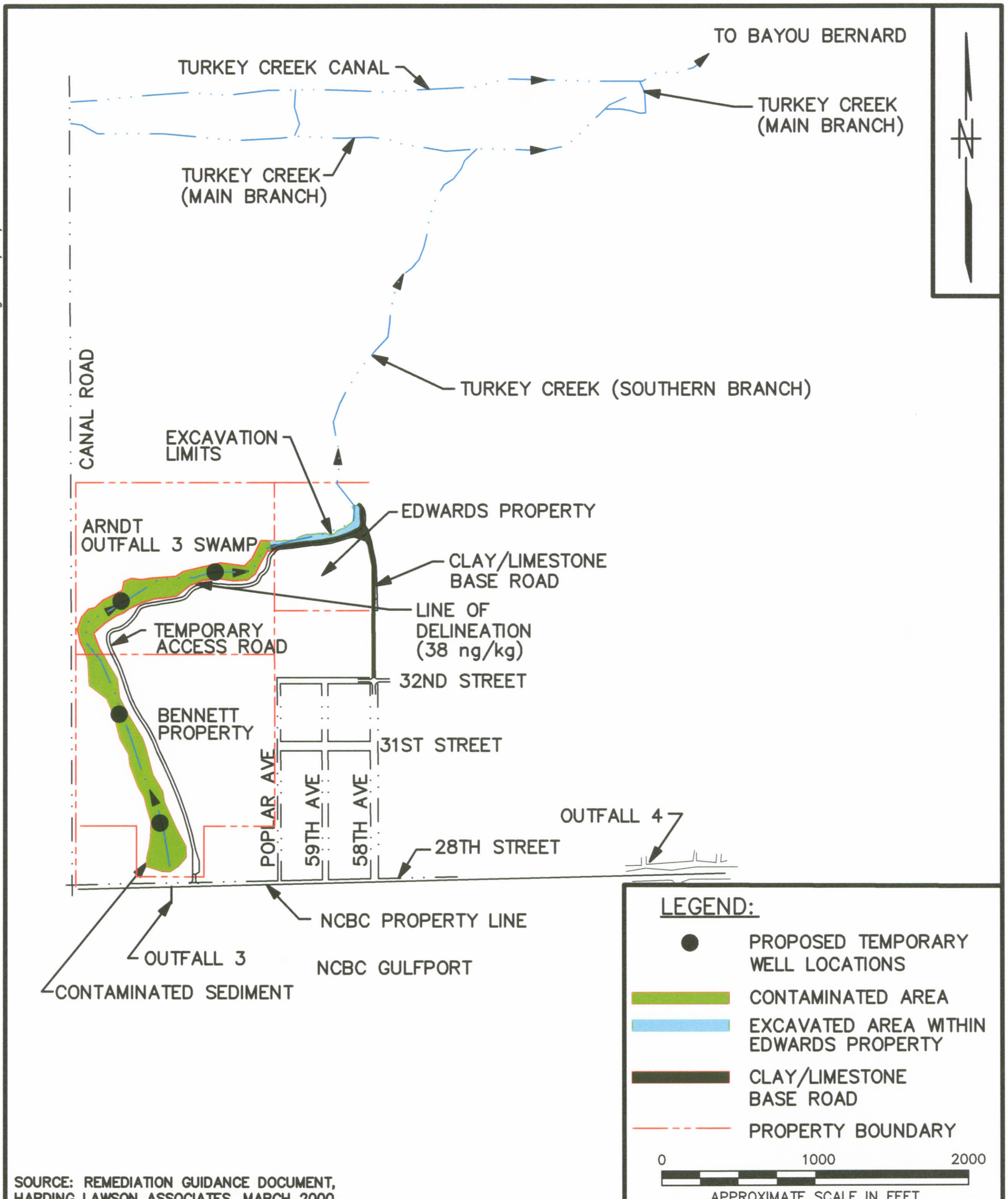

SOURCE: REMEDIATION GUIDANCE DOCUMENT, HARDING LAWSON ASSOCIATES, MARCH 2000.

DRAWN BY HJB	DATE 6/3/03		AREAL EXTENT OF OFF-BASE CONTAMINATED MEDIA SITE 8 VERIFICATION SAMPLING AND ANALYSIS PLAN NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI	CONTRACT NO. 0567	
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COST/SCHED-AREA				APPROVED BY	DATE
SCALE AS NOTED				DRAWING NO. FIGURE 2-4	REV. 0

3.0 VSAP RATIONALE/DATA QUALITY OBJECTIVES

3.1 REMEDIAL OBJECTIVES

Remedial objectives are established for the following media. PRGs discussed in the following text were established in the Focused Feasibility Study (FFS) for Site 8 (TtNUS, 2003a).

- **Off-base AOC sediments** - During the RA, the Navy will remove approximately 27,700 yd^3 of dioxin-contaminated sediment located on off-base property owned by Mr. G.D. Arndt (the Arndt property) and Mr. P.W. Bennett (the Bennett property) as shown in Figure 2-4. Upon completion of excavation activities, verification sampling and analysis will be performed to confirm that remaining dioxin concentrations in the off-base AOC sediment are less than the PRG of 38.2 ng/kg established for the Arndt and Bennett properties. This PRG may be lowered based on the outcome of future ecological studies that may be conducted within the off-base AOC.

- **On-base drainage channel sediments** - During the RA, the Navy will remove approximately 17,600 yd^3 of sediment contained within the on-base drainage channels shown on Figure 2-3. Upon completion of excavation activities, verification sampling and analysis will be performed to confirm that remaining dioxin concentrations are less than the PRG of 38.2 ng/kg established for the on-base drainage channels.

- **Site 8 groundwater** - After stabilization and capping activities are completed, groundwater will be sampled from permanent monitoring wells surrounding the landfilled material at Site 8A to verify that dioxin concentrations in off-base AOC groundwater are less than the PRG of 30 pg/L.

- **Off-base AOC groundwater** After excavation activities in the off-base AOC are completed, temporary monitoring wells will be installed and sampled to verify that dioxin concentrations in off-base AOC groundwater are less than the PRG of 30 pg/L.

- **Materials handling pad subgrade (Site 8B soil)** - During the RA, a bermed and lined materials handling pad may be constructed at Site 8B. If constructed, the pad would be removed upon completion of stabilization/capping activities, and the remaining soils (the pad's subgrade) would be sampled to verify that dioxin concentrations are less than the PRG of 38.2 ng/kg.

3.2 SAMPLING APPROACH/DATA QUALITY OBJECTIVES

Section 3.2 outlines the approach to be used to verify that remedial actions have achieved the objectives discussed in Section 3.1. Section 4.0 provides a detailed description of the field activities to be performed to implement the sampling approach.

3.2.1 Off-base AOC Sediments

Per MDEQ recommendations, the sampling approach for the off-base AOC is based on Michigan Department of Environmental Quality (DEQ) guidance (Michigan DEQ, 1994) entitled Guidance Document: Verification of Soil Remediation, which is included as Appendix A. During the first phase of excavation activities, approximately 18 inches of sediment will be removed along the existing delineated extent of contamination within the off-base AOC. Upon completion of this initial excavation phase, the excavation limits will be surveyed by a State of Mississippi licensed surveyor, and a sampling grid will be established across the excavated area using a 30-foot grid interval (see Appendix A).

After the sampling grid has been established, a random number generator will be used to choose 25 percent of the grid nodes for sampling. To ensure that the sampling points are spatially distributed throughout the excavation area, one of every four grid nodes will be randomly selected for sampling (i.e., if the grid nodes were sequentially numbered, one sample would be randomly selected from grid nodes 1 through 4, one randomly selected from grid nodes 5 through 8, etc.). Sample locations will be determined after the first phase of excavation activities so as not to bias the excavation. Based on the existing delineated extent, it is estimated that 150 sediment locations will be sampled within the off-base AOC. This estimate will be confirmed once the sampling grid has been established for the off-base AOC. One sediment sample will also be collected for dioxin analysis on the eastern side of the SRT that is on the border of the Edwards and Arndt property. This sample will be collected to verify that dioxins have not migrated onto the Edwards property since the completion of the 2001 sediment removal.

As established in the FFS for Site 8 (TtNUS, 2003a), the PRG for off-base AOC sediment is the MDEQ Tier 1 soil/sediment target remediation goal (TRG) concentration of 38.2 ng/kg for restricted (industrial/occupational) use. To achieve the remedial objective for off-base AOC sediments, the 95 percent upper confidence limit (UCL) of the mean TEQ concentration of the sample results must be equal to or less than 38.2 ng/kg. Statistical analysis of data will be performed in accordance with the Michigan DEQ guidance (see Appendix A).

If the 95 percent UCL of the mean TEQ concentration is greater than the PRG (38.2 ng/kg), “hot spot” excavations will be performed until the PRG is achieved. As discussed during the January 13 and 14 meeting of the NCBC Tier I Partnering Team, a 30-foot radius and/or topographic indicators will be used to establish the “hot spot” removal area. From these “hot-spot” areas, a minimum of 6 inches of sediment will be excavated. Afterwards, field personnel will collect three samples from each “hot spot” area for dioxin analysis. The average result of the new samples collected within a “hot spot” will replace the original result in the UCL calculation. “Hot spot” excavations will continue until the 95 percent UCL concentration is less than 38.2 ng/kg. Also, dioxin point concentrations greater than 100 ng/kg will not be allowed to remain in the sediment.

3.2.2 On-base Drainage Channel Sediments

The sampling approach for the on-base drainage channels contiguous to Site 8 is also based on Michigan DEQ guidance (Michigan DEQ, 1994). Upon completion of the initial excavation phase, a 30-foot linear sample grid will be established along the centerline of the on-base drainage channels. As discussed in Appendix A, the grid interval is established at 30 feet; however, the on-base drainage channels have a maximum width of 30 feet and in most cases are narrower than 30 feet. Consequently, a linear grid system along the centerline of the drainage channel is proposed, which will ensure that depositional areas will be sampled in lieu of the top portions of the drainage channels’ sideslopes.

A random number generator will be used to choose 25 percent of the grid nodes for sampling. To ensure that the sampling points are spatially distributed throughout the excavation area, one of every four grid nodes will be randomly selected for sampling (i.e., if the grid nodes were sequentially numbered, one sample would be randomly selected from grid nodes 1 through 4, one randomly selected from grid nodes 5 through 8, etc.). Sample locations will be determined after the first phase of excavation activities so as not to bias the excavation. Based on the existing delineated extent of contamination (consisting of drainage channels within and outside the boundaries of Site 8A), it is estimated that 118 sediment locations will be sampled within the on-base drainage channels.[1] One sediment sample will also be collected for dioxin analysis on the downgradient (western) side of the SRT near Outfall 3. This sample will be collected to verify the effectiveness of the SRT.

As established in the FFS (TtNUS, 2003a), the PRG for the on-base drainage channels is the MDEQ Tier 1 soil/sediment TRG concentration of 38.2 ng/kg for restricted use. To achieve the remedial objective for the on-base drainage channel sediments, the 95 percent UCL of the mean TEQ concentration of the sample results must be equal to or less than 38.2 ng/kg. Statistical analysis of data will be performed in accordance with the Michigan DEQ guidance (see Appendix A).

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[1] Approximately 14,125 linear feet of on-base drainage channels will be excavated. (14,125 ft)*(1 grid node/30 feet)*(25%) = 118 sample locations

If the 95 percent UCL of the mean TEQ concentration is greater than the PRG (38.2 ng/kg), "hot spot" excavations will be performed until the PRG is achieved. As discussed during the January 13 and 14 meeting of the NCBC Tier I Partnering Team, a 30-foot radius and/or topographic indicators will be used to establish the "hot spot" removal area. From these "hot-spot" areas, a minimum of 6 inches of sediment will be excavated. Afterwards, field personnel will collect three samples from each "hot spot" area for dioxin analysis. The average result of the new samples collected within a "hot spot" will replace the original result in the UCL calculation. "Hot spot" excavations will continue until the 95 percent UCL concentration is less than 38.2 ng/kg. Also, dioxin point concentrations greater than 100 ng/kg will not be allowed to remain in the sediment.

3.2.3 Site 8 Groundwater

As discussed in Section 3.1, the excavated sediment from the on-base drainage channels and off-base AOC and the soil ash currently residing at Site 8A will be blended, stabilized, and consolidated/landfilled at Site 8A. A protective cap will then be placed over the stabilized material. To ensure that dioxin contained within the stabilized media is not leaching to the groundwater at levels greater than the PRG established in the FFS [the USEPA Maximum Contaminant Level (MCL) and MDEQ groundwater TRG of 30 pg/L], four existing permanent groundwater monitoring wells screened in the surficial aquifer (GPT-08-05, GPT-08-06, GPT-08-09, and GPT-08-12) will be sampled for dioxins. The locations of these existing monitoring wells are shown on Figure 3-1.

3.2.4 Off-base AOC Groundwater

Upon completion of sediment removal activities in the off-base AOC, four temporary groundwater monitoring wells will be installed in the surficial aquifer of this area. The temporary wells will be installed using direct push technology (DPT) and sampled to verify that dioxin concentrations in the groundwater do not exceed the PRG established in the FFS (the USEPA MCL and MDEQ groundwater TRG of 30 pg/L). The temporary wells will be installed at the edge of the haul road used to access the off-base AOC.

Due to the highly organophilic nature of dioxins, it is anticipated that after the source of dioxin contamination is removed from the off-base AOC, little or no impact to off-site groundwater will remain. If groundwater dioxin concentrations are less than the PRG, no further action will be proposed for off-base groundwater. If dioxin groundwater concentrations are found to be greater than the dioxin PRG, a groundwater sampling program will be proposed to assess concentration trends.

3.2.5 Materials Handling Pad Subgrade

As discussed in Section 3.1, a bermed and lined materials handling pad may be constructed on Site 8B and used during the mixing/stabilizing portion of the RA. If constructed, the pad would be removed upon completion of the mixing/stabilizing activities, and the soil (subgrade) below the pad would be sampled to verify that dioxin concentrations in remaining soils are less than the MDEQ soil/sediment TRG for restricted use (38.2 ng/kg). Ten samples are proposed within the location chosen for use as a materials handling pad.

If the 95 percent UCL of the mean TEQ concentration of the soil samples were to be equal to or less than 38.2 ng/kg, no further action would be taken. If the 95 percent UCL of the mean TEQ concentration were to be greater than 38.2 ng/kg, “hot spot” excavations would be performed until the PRG is achieved. “Hot spot” areas would be delineated using the closest clean sample. A minimum of 6 inches of soil would be excavated from these “hot-spot” areas. Afterwards, field personnel would collect three samples from each “hot spot” area for dioxin analysis. The average result of the new samples collected within a “hot spot” would replace the original result in the 95 percent UCL calculation.

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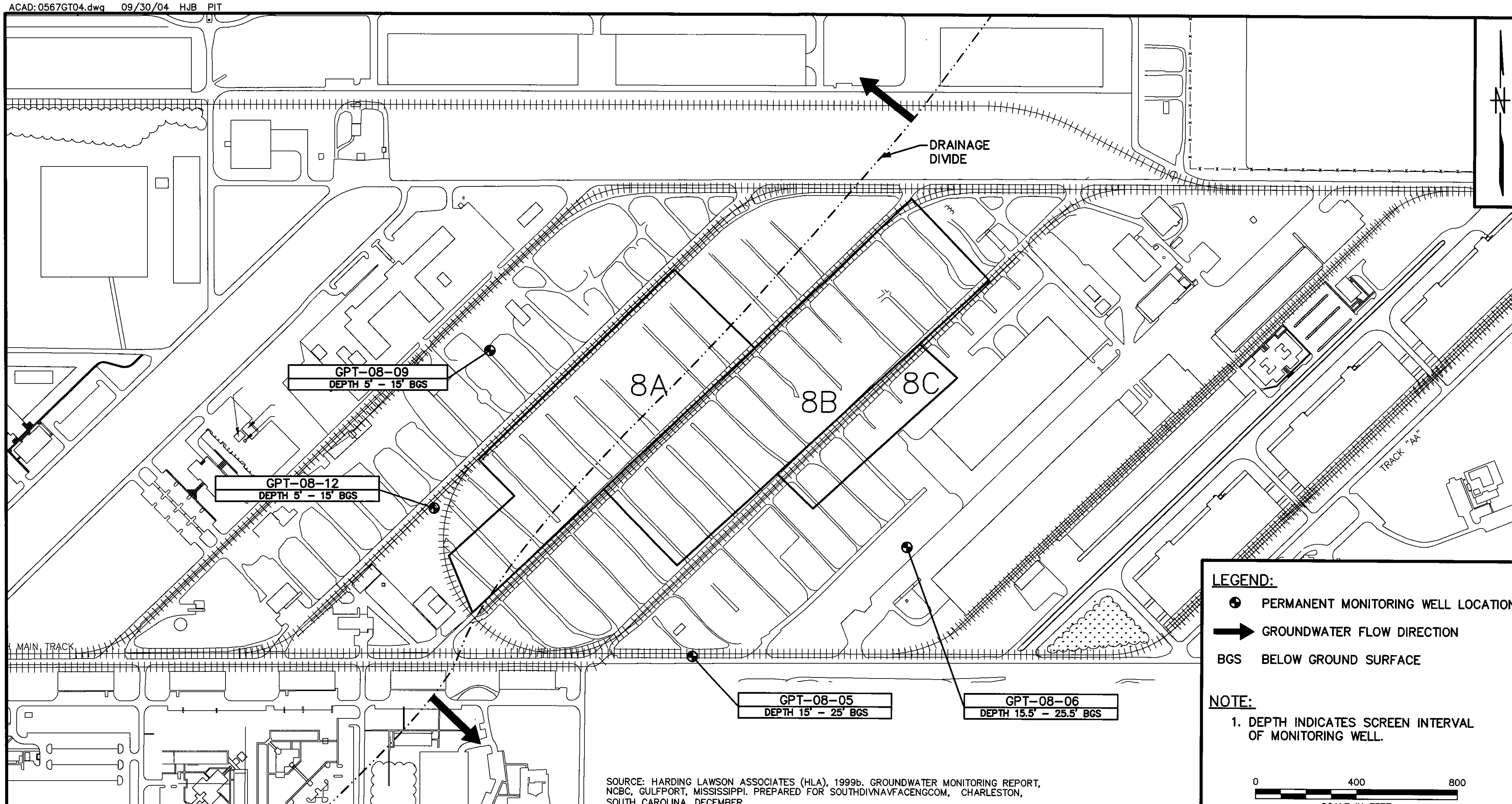

SOURCE: HARDING LAWSON ASSOCIATES (HLA), 1999b. GROUNDWATER MONITORING REPORT, NCBC, GULFPORT, MISSISSIPPI. PREPARED FOR SOUTHDIVNAVFACENGCOM, CHARLESTON, SOUTH CAROLINA. DECEMBER.

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DEPARTMENT OF THE NAVY SOUTHERN DIV FACILITIES ENGINEERING COMD

MONITORING WELL LOCATIONS
VERIFICATION SAMPLING AND ANALYSIS PLAN
SITE 8 – FORMER HERBICIDE ORANGE STORAGE AREA
NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 0567
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4.0 FIELD PROCEDURES

Section 4.0 provides a detailed description of the field procedures to be performed to implement the sampling approach described in Section 3.0. All field personnel will follow the health and safety procedures outlined in the HASP included as Appendix B.

4.1 MOBILIZATION

Field mobilization activities will include travel and on-site preparatory activities. These activities will include the marking of sample locations; the receiving, storage and testing of field equipment; and the initiation of the field data management system.

4.2 FIELD DOCUMENTATION

Field Logbooks

Dedicated field logbooks will be used to record pertinent field activities. The project manager's name, the field operation leader's (FOL)'s name, the project name and location, and the project number will be recorded on the inside of the front cover of all logbooks. Entries will be recorded with waterproof, non-erasable ink. Each page of the logbook will be numbered and dated. All entries must be legible and contain accurate and complete information about an individual's project activities. At the end of all entries for a particular day, or a particular event if appropriate, the investigator will draw a diagonal line across the page below the last entry and initial indicating the conclusion of entries. All entries will be objective, factual, and free of personal feelings or other inappropriate language. Corrections will be made by drawing a single line through the error and entering the correct data. All corrections will be initialed and dated.

Sample labels

Sample labels will be completed with waterproof, non-erasable ink and will contain the following information:

- Project number
- Sample ID
- Date and time of sample collection
- Designation of sample as grab or composite
- Sample type (soil, groundwater, etc.)
- The signature of the sampler(s)

- Indication as to whether the sample is preserved or unpreserved
- Analyses to be performed

After information is recorded on the label, the label will be placed on the appropriate sample container and covered with clear packing tape to help protect the label.

Location/Sample Nomenclatures

Each sample will be assigned a unique identification number consisting of a five-segment, alphanumeric code that identifies the following:

Site Location – Medium – VS[1] – Sample Number – Sample Round

Table 4-1 presents a detailed description of the sample nomenclature to be used for VSAP activities.

4.3 UTILITY CLEARANCE

Mississippi One-Call or base personnel will conduct utility clearance at all required locations. All intrusive sample locations will be cleared by reviewing existing records and using magnetic location devices. After clearance, each location will be clearly marked (i.e., wooden stake, pin flag, etc) indicating that the location has been cleared for underground utilities. The FOL will accompany the base utility clearance personnel to the site to review any restrictions to DPT activities.

4.4 SOIL AND SEDIMENT SAMPLING

As discussed in Section 3.0, sediment samples will be collected within the on-base drainage channels and the off-base AOC, and surface soil samples will be collected from the subgrade of the Site 8B materials handling pad. Within each drainage channel, sediment samples will be collected from downstream to upstream to prevent disturbance and possible cross-contamination of downstream sediments. Sediment samples will be identified by a licensed surveyor prior to sampling. Approximate locations for the Site 8B soil samples will be used. All sample locations will be marked using pin flags or survey stakes wrapped with fluorescent ribbon. At each location, one grab sample will be collected from a depth of 0 to 12 inches below ground surface (bgs) using a stainless steel spoon. Next, the collected material will be mixed in a stainless steel bowl. To ensure adequate mixing, the material will be stirred in a circular fashion, reversing direction, and occasionally turning the material over. Once thoroughly mixed, the sample will be placed into the appropriate sample containers, which will then be labeled, placed in a

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[1] Designates a verification sample

sealed plastic bag, and placed in a cooler on ice. A description of the physical appearance of each sample and sampling location will be recorded on a sample log sheet (provided in Appendix A).

4.5 DIRECT PUSH SAMPLING

After sediment clean-up goals in the off-base AOC have been achieved, four DPT borings will be installed within the off-site AOC to a total depth of 15 feet bgs for the collection of groundwater samples. The approximate locations are shown on Figure 2-4.

Groundwater samples will be collected at each direct push location. After the drill rods have been pushed to the desired depth, just below the water table, a screen will be exposed allowing groundwater to flow into the rods. A length of Teflon® tubing with a stainless steel check valve inserted into the end will be lowered into the drill rods to approximately the midpoint of the screened interval. The sampler will then move the tubing with a rapid up and down motion forcing water up the tubing and to the surface. Prior to the collection of the groundwater samples, an attempt will be made to ensure that fresh formation water is present in the drill rods. This will be accomplished by removing a volume of water sufficient to stabilize the following water quality parameters: pH, specific conductance, temperature, and turbidity. After these parameters have stabilized, as described in Section 4.6, the sample will be collected.

4.6 MONITORING WELL SAMPLING

The following section discusses the sampling of four existing permanent monitoring wells located around the perimeter of Site 8. Figure 3-1 presents the locations for the monitoring wells.

A total of four permanent and four temporary shallow monitoring wells will be sampled. Prior to sampling, the wells will be purged of approximately three to five well volumes. The well volume (volume of water within the well) will be calculated prior to initiating the purge. This will be done by determining the inside diameter of the well and by measuring and recording the total depth of the well and the depth to water from the top of the well casing. The water level is then subtracted from the total depth and this length is then multiplied by the appropriate factor from Table 4-2 to obtain the amount of water, in gallons, within the well. Additionally, water quality parameters will be measured at the initiation of purging, and at a minimum, after the removal of each well volume. More frequent measurements may be necessary to confirm stabilization. Purging will continue until at least three well volumes have been removed and the water quality parameters (pH, specific conductance, and temperature) have stabilized and turbidity has either stabilized or is less than 10 Nephelometric Turbidity Units (NTUs). Stabilization occurs when the pH measurements remain constant within 0.1 standard units (SUs), specific conductance varies by no more than 10 percent, and the temperature remains constant for three consecutive readings (USEPA, 2001). If after removing five well volumes from the well, the parameters have still not stabilized, it will be the discretion of the FOL whether to sample or to continue purging.

Sampling will be conducted as soon as possible after the purging process. Groundwater samples will be collected using a peristaltic pump and Teflon® tubing, and the collected groundwater will be placed into the appropriate sample containers. The sample containers will then be labeled, placed in a sealed plastic bag, and placed in a cooler on ice. Each sample will be collected using new tubing to prevent the possibility of cross contamination.

4.7 DECONTAMINATION PROCEDURES

All sampling and drilling equipment must be cleaned prior to use and after each subsequent use. A decontamination pad will be constructed in the off-base AOC for use in decontaminating downhole drilling equipment. The area should be relatively level and free of known surface contamination. The pad will be bermed and lined to minimize leakage. Racks used to hold equipment during cleaning will be high enough to prevent the equipment from being splashed. After cleaning, equipment will only be handled by personnel wearing clean gloves to prevent recontamination. The following is a description of the materials to be used in the decontamination process and the decontamination procedures to be used for the specific types of equipment (USEPA, 2001).

Specifications for Cleaning Materials:

- Soap - standard phosphate-free laboratory detergent (e.g. Liquinox).
- Solvent - pesticide grade isoproponal.
- Tap water - from any municipal water system.
- Analyte Free Water - deionized (DI) water that should contain no detectable heavy metals or other inorganic analytes.

Procedures:

Sampling equipment:

1. Clean with tap water and soap, being sure to remove particulate matter and surface films, using a brush if necessary.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with DI water.
4. Rinse thoroughly with solvent. PVC or plastic items should not be solvent rinsed.

5. Rinse thoroughly with DI water.
6. Remove from the decontamination area and cover with clean plastic. If equipment is to be stored overnight, it will be wrapped in aluminum foil and covered with clean unused plastic.

Water Level Meter:

1. Clean with tap water and soap.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with DI water.

Redi-Flo2® Pump:

CAUTION - the pump should be unplugged prior to cleaning.

1. Scrub the exterior of the pump, the electrical cord, and the garden hose with a brush, soap, and tap water. Do not wet the electrical plug.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with DI water.
4. Place the equipment in a clean plastic bag.

The check valve will be cleaned as follows:

1. Disassemble the check valve assembly.
2. Scrub all components with a brush, soap, and tap water.
3. Rinse thoroughly with DI water.
4. Reassemble.

Downhole Drilling Equipment:

1. Steam clean with soap and high-pressure hot water. If necessary, a brush will be used to remove particulate matter not removed by steam cleaning.
2. Rinse thoroughly with tap water.
3. Remove from the decontamination pad and cover with clean, unused plastic. If the equipment will be stored overnight, the plastic will be secured to ensure that it stays in place.

4.8 LAND SURVEYING

The horizontal location and the top of casing elevation of each permanent monitoring well and DPT well will be surveyed by a TtNUS-subcontracted, State-licensed land surveyor. The horizontal location and ground surface elevation of all sample locations will also be surveyed. All locations will be referenced to site features such as building corners, roads, etc. It is assumed that sufficient survey control is present within 1 mile of the site.

4.9 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) management includes labeling, record keeping, and staging of materials. All drums will be labeled with the following information:

- Source of material (i.e. boring/well ID, decontamination pad, etc.)
- Matrix (i.e. soil, groundwater, decontamination water, etc.)
- Date generated (mmddyy)
- Contractor name and contact phone number

PPE will be double bagged and placed in facility dumpsters. NCBC Gulfport will be responsible for disposal costs and manifests associated with the disposal of all IDW.

4.10 DEMOBILIZATION

Demobilization will occur at the conclusion of field activities. Activities that will occur during this phase include the return of all rental field equipment, the verification of proper IDW documentation and staging by the FOL, and the securing of the site.

TABLE 4-1

SAMPLE NOMENCLATURE
VERIFICATION SAMPLING AND ANALYSIS PLAN FOR SITE 8
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Area	Sample Identification Numbers/Notes
Off-base AOC sediment(1)	08-SD-VS-119-01 through 08-SD-VS-268-01 Previous verification samples collected in the off-base AOC were numbered 101 to 118 (TtNUS, 2002 and 2003b). Approximately 150 sediment locations are estimated to be sampled for the off-base AOC. This estimate will be confirmed after the sampling grid has been established in the off-base AOC.
On-base drainage channels sediment(1)	08-SD-VS-501-01 through 08-SD-VS-618-01
Off-base AOC groundwater(2)	08-GW-VS-001-01, 08-GW-VS-002-01, 08-GW-VS-003-01, 08-GW-VS-004-01
On-base groundwater	08-GW-VS-005-01, 08-GW-VS-006-01, 08-GW-VS-009-01, 08-GW-VS-012-01.
Materials Handling Pad Subgrade(1)(2)	08B-SS-VS-001-01 to 08B-SS-VS-010-01.

1. Denotes the sediment or soil samples to be collected during the first phase of excavation. If "hot spot" excavations are conducted, the original sample location from the "hot spot" would be resampled after the excavation. For instance, if sample location 08-SD-VS-001-01 were to be resampled, the corresponding sample ID would be 08-SD-VS-001-02.
2. Denotes sample identification number for the first round of sampling. For subsequent groundwater sampling rounds, the last two digits of the sample identification number would be -02, -03, etc.

08: Areas impacted by previous HO storage at Site 8.
8B: Site 8B Material Handling Pad subgrade sample.
GW: Groundwater sample.
SD: Sediment sample.
SS: Surface soil sample.
VS: Verification sample.

TABLE 4-2

WELL CASING DIAMETER VERSUS VOLUME
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Well Casing Inside Diameter (inches)	Gallons/Foot of Water
1	0.041
2	0.163
4	0.653

5.0 LABORATORY ANALYSES

This section identifies the number of samples to be collected per sampling method per matrix and the total number of samples per analysis, including QA/QC samples.

All soil and sediment samples collected as part of VSAP activities will be analyzed for dioxins using USEPA SW-846 Method 4025m. All groundwater samples will be analyzed for dioxins using USEPA SW-846 Method 8290. Ten percent of the samples locations that undergo Method 4025m analysis will also be sampled and analyzed using Method 8290 for confirmation purposes. TEQ concentrations of TCDD will be calculated for each sample in accordance with the Interim Report on Data Methods for Assessment of TCDD Risks (USEPA, 1989).

QA/QC samples will be collected in the frequency described in the QAPP (see Appendix C) and as displayed in Table 5-1. Sample container, preservation, and laboratory holding time requirements for sample collection are provided in Table 5-2.

TABLE 5-1

SUMMARY OF REQUIRED SAMPLES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Location	Media	Sample Locations	Field Duplicates(1)	Rinsates (2)	MS/ MSD(3)	Total
Samples to be analyzed using Method 4225m analysis						
Off-base AOC	Sediment(4)(5)	150	15	5	8	178
On-base drainage channels	Sediment(4)(5)	118	12	5	6	141
Materials Handling Pad	Soil(4)(5)	10	1	1	1	13
Samples to be analyzed using Method 8290 analysis						
Off-base AOC	Sediment(4)(5)(6)	15	--	--	--	15
	Groundwater	4	1	1	1	7
On-base drainage channels	Sediment(4)(5)(6)	12	--	--	--	12
Site 8	Groundwater	4	1	1	1	7
Materials Handling Pad	Soil(4)(5)(6)	1	--	--	--	1

1. One per 10 samples collected.
2. One per day per matrix.
3. One per 20 samples collected per matrix.
4. Samples to be collected during the first phase of excavation activities. Additional sampling may be required if PRGs are not met after the first phase.
5. Sample number estimated. This estimate will be confirmed after the sampling grid has been established in the off-base AOC.
6. Collected to verify and confirm soil and sediment results obtained using Method 4025m.

MS/MSD = matrix spike/matrix spike duplicate.

TABLE 5-2

SAMPLE CONTAINER, PRESERVATION, AND LABORATORY HOLDING TIME REQUIREMENTS
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Analysis (Method)	Number of Containers Per Sample	Container Type	Preservation	Holding Time
SEDIMENT				
Dioxin (SW-846 4025) and (SW-846 8290)	1	4-ounce clear wide mouth glass jar	4ºC	30 days to extraction 45 days to analysis
GROUNDWATER				
Dioxin (SW-846 4025)	1	1-Liter Amber bottle	4ºC	30 days to extraction 45 days to analysis

6.0 DATA MANAGEMENT

This section will discuss the methods to be used to manage the data generated during verification sampling activities. This includes the tracking of data in the field and data validation.

6.1 ON-SITE DATA MANAGEMENT

On-site data management involves the day-to-day recording of all sampling and field activities in the field. A project database will be initiated in the field to promote the proper collection, storage, and documentation of field activities. The following data will be entered into the project database in the field:

- Sample information (i.e. identification, sample matrix, sample depth, collection time, analyses, etc.).
- Location information.
- Chain of custody information.
- Shipping data.
- Field descriptions.
- Photographic logs.

The FOL and/or sample coordinator will be responsible for entering the data into the database in the field.

6.2 DATA VALIDATION

All dioxin data will be subjected to full data validation. The data will be assessed using precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters using the National Validation Functional Guidelines for Chlorinated Dioxin/Furan Data review (August 2002) and TtNUS Standard Operating Procedures.

REFERENCES

CH2M Hill, Constructors Inc. (CCI), 2003. *Draft Technical Memorandum for the Summary of Dioxin Contaminated Ditch Soil Excavation Activities, Naval Construction Battalion Center (NCBC) Gulfport, Mississippi.* Prepared for Southern Division Naval Facilities Engineering Command (SOUTHDIVNAVFACENGCOM), North Charleston, South Carolina, January.

Michigan Department of Environmental Quality (Michigan DEQ), 1994. *Guidance Document: Verification of Soil Remediation*, Environmental Response Division, Waste Management Division, April.

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Tetra Tech Nus, Inc. (TtNUS), 2002. *Excavation and Confirmation Sampling Report for the Edwards Property, Gulfport, Mississippi.* Prepared for SOUTHDIVNAVFACENGCOM, North Charleston, South Carolina, August.

TtNUS, 2003a. *Focused Feasibility Study, Site 8, Herbicide Orange Storage Area at NCBC, Gulfpor, Mississippi.* Prepared for SOUTHDIVNAVFACENGCOM, North Charleston, South Carolina, March.

TtNUS, 2003b. *Draft Report*, *Excavation of Sediments Adjacent to Canal Road Culvert, NCBC Gulfport, Mississippi.* Prepared for SOUTHDIVNAVFACENGCOM, North Charleston, South Carolina. April.

United States Environmental Protection Agency (USEPA), 1989. Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and -dibenzofurans (CDDs and CDFs) and 1989 Update. U.S. Environmental Protection Agency, Risk Assessment Forum, Washington, DC; EPA/625/3-89/016.

USEPA Region 4, 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), Athens, GA, November. www.epa.gov/region4/sesd/eisopqam/eisopqam.html

USEPA, 2002. National Functional Guidelines for Chlorinated Dioxin/Furan Data Review, USEPA Analytical Operations/Data Quality Center (AOC). Final. (OSWER 9240.1-37 - EPA 540-R-02-003). August.

APPENDIX A

SAMPLING APPROACH
SUPPORTING MATERIALS

A.1 MICHIGAN SOIL VERIFICATION GUIDANCE

A.2 VERIFICATION SAMPLING GRID INTERVAL RATIONALE

A.3 EXAMPLE SOIL AND SEDIMENT SAMPLE LOG SHEET

A.1 MICHIGAN SOIL VERIFICATION GUIDANCE

State of Michigan
DEQ
Department of Environmental Quality

WASTE MANAGEMENT DIVISION

GUIDANCE DOCUMENT

VERIFICATION OF SOIL REMEDIATION

ENVIRONMENTAL RESPONSE DIVISION

WASTE MANAGEMENT DIVISION

APRIL 1994, Revision 1

PLEASE NOTE: STATISTICAL TABLES MAY NOT PRINT COMPLETELY WHEN THIS DOCUMENT IS PRINTED AND SHOULD BE USED AS A REFERENCE ONLY. TO ASSURE THAT THE TABLES ARE ACCURATE, PLEASE REQUEST A PAPER COPY OF THIS DOCUMENT. Additionally, this HTML encoded version of the VSR document will only be accurately displayed with browsers that can support tables, superscripted and subscripted characters (i.e. Internet Explorer 3.0 and Netscape 3.0).

EXECUTIVE SUMMARY

The document provides guidance for sampling soils to verify that soil contamination has been remediated to Type A or Type B criteria in accordance with Act 307 P.A. 1982, as amended. This document is not designed to either guide investigations to determine whether a release has occurred or the nature and extent of an identified release, nor to guide due diligence by a potential property owner. Issuance of this guidance document does not invalidate remedial action plans (RAPS) or clean-ups previously conducted and approved by the DNR.

Soil sampling and analyses to verify that site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. The guidance document

presents acceptable methods for verifying soil remediation. It contains guidance on soil sampling protocols and documentation necessary to characterize and verify cleanup of contaminated soils. The document provides recommended procedures for establishing soil background concentrations, sampling grids, chemical constituent evaluations, statistical comparisons, verifying excavation and in-situ and ex-situ remedies, evaluating treated soils, and soil characterization. The recommended procedures are **not *absolutes***. Other methods are available to verify soil remediation. The Department of Natural Resources will evaluate other sampling and statistical strategies on a case-by-case basis.

The guidance document is divided into two parts:

- **Part 1** contains guidance for small site cleanup verification (less than 10,890 square feet--<0.25 acre). It is a "biased" sampling strategy recommending soil sampling from areas most likely to contain contamination.

- **Part 2** contains guidance for soil characterization and cleanup verification of medium and large sites (greater than 10,890 square feet-->0.25 acre). It is a statistical random sampling strategy that minimizes biases in sampling.

Both sampling strategies require discrete soil samples. Compositing samples for cleanup verification is not accepted without prior DNR approval.

The guidance document contains verification checklists and reporting sections. The reporting sections should be carefully followed in reporting sampling rationale.

Reader's Note: Questions regarding this guidance document should be directed to Department staff you are currently working with for your project or site.

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DNR--GUIDANCE DOCUMENT, PART 1

SMALL SITE SOIL CLEANUP VERIFICATION (LESS THAN 10,890 SQUARE FEET)

Part 1 of this document is a guide for a biased sampling strategy to verify that soil contamination has been remediated at sites no greater than 0.25 acres (small sites). Soil sampling and analyses to verify that a site remediation is complete can result in two basic errors.

- Declaring a site clean when it is contaminated
- Declaring a site contaminated when it is clean

A soil sampling plan submitted to the DNR must minimize these errors. Part 1 presents a biased sampling method of verifying soil remediation at small sites. The biased sampling approach specified in this guidance recommends soil sampling from areas most likely to still exceed cleanup criteria. The location of the soil sample points relies on a site specific analysis of the released or contaminant distribution and the soil types encountered. The remediation is verified using a point by point comparison of sample values with the appropriate cleanup criteria. If the cleanup criteria are exceeded at any sampled point, the biased sampling methodology may require additional remediation at that point until the criteria are met. Verification of cleanup utilizing the biased approach should generally require fewer samples to demonstrate attainment than by using the unbiased approach. DNR will evaluate other sampling and statistical strategies on a case-by-case basis.

Any biased sampling plan, whether presented in the guidance document or some other geostatistical approach, requires professional judgment. Therefore, documentation and the rationale used to select sample locations are extremely important. The report section (page 9) of this guidance document should be carefully followed.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

Part 1 is divided into five main sections: Verifying Excavation Remedies, Verifying In-Situ and Ex-Situ Soil Remedies, Sample Analysis, Background Soil Samples, and Reports. The excavation and in-situ remediations require different strategies for verification. Guidance is presented for statistically determining background concentrations of compounds/contaminants. Guidance for reporting all appropriate information is presented to facilitate remediation approval.

VERIFYING EXCAVATION REMEDIES

Verifying that contaminated soil is remediated by means of excavation requires samples from the excavation bottom and sidewalls. Tables and formulas presented provide the minimum number of samples necessary to verify cleanup for various size excavations. The biased approach specified in this guidance recommends soil sampling from areas most likely to still exceed cleanup criteria. The location of the sample collection points relies on site specific analysis of the release or contaminant distribution and the soil types encountered in the excavation. The minimum number of excavation floor and sidewall samples required to demonstrate verification using a point by point comparison with the cleanup criteria are specified. If the cleanup criteria are exceeded at any point, this verification methodology may require additional excavation at that point until the criteria are attained.

Sampling and analyzing the locations most likely to have contaminants can minimize the number of samples needed to verify remediation is complete. Since professional judgment and site specific knowledge are required for selecting sampling locations, the rationale used to select these locations must be documented in the verification report.

SAMPLE LOCATIONS

Using a biased sampling approach, samples must be collected where they will most likely encounter contamination which could exceed the cleanup criteria. This will minimize the number of samples needed to verify a site is remediated. A sampling strategy that uses bias to choose sample locations is recommended. While it is inappropriate for this guidance document to dictate exact locations for sample collection in this strategy, site specific information (e.g., the location of leaks in an underground storage tank or its piping) from the remedial investigation concerning the release and soil conditions should be used along with professional judgment and the general guidance provided here to select appropriate soil sampling locations.

EXAMPLE: It would be incorrect to sample the north side of an excavation pit as extensively as the south side when the leak was confirmed on the south side of the tank.

Because a site must be remediated to a certain degree before approval can be considered, an analysis of data generated by a prior investigation should yield information for the verification analysis. The field personnel present during remediation should be sufficiently familiar with the conditions on-site to implement an appropriate verification strategy. A soil verification strategy should incorporate all pertinent biases of a site which may include, but are not limited to, those listed below.

- preferential pathways of contaminant migration
- source areas
- stained soils

- other site specific "clues" (e.g., fractures in clays)
- changes in soil characteristics (e.g., sand/clay interfaces)
- soil types and characteristics

NUMBER OF SAMPLES

The following tables are used to determine the minimum number of samples necessary from the floor and sidewalls of an excavation no greater than 0.25 acres using a biased sampling approach. If the area of the excavation floor exceeds 10,890 square feet, use Part 2 of this guidance document. A site may have an appropriate number of samples collected for verification, but, if the samples are not collected from the appropriate locations (discussed previously) and adequately reported, remediation may not be considered adequate. All sample locations must be accurately located, described, and reported. It should be noted that "excavation" as used here refers only to that area excavated for remediation purposes and being verified to meet Type A/Type B cleanup criteria.

Number of Excavation Floor Samples

Determine the minimum number of excavation floor samples from the table below.

TABLE 1	
EXCAVATION FLOOR SAMPLES	
Area of Floor (sq ft)	*Number of Samples*
< 500	2
500 < 1,000	3
1,000 < 1,500	4
1,500 < 2,500	5
2,500 < 4,000	6
4,000 < 6,000	7
6,000 < 8,500	8
8,500 <10,890	9

Number of Excavation Sidewall Samples

Sidewall samples are required to verify that the horizontal extent of contamination has been remediated. Use Table 2 to determine the minimum number of required sidewall samples. In no case is less than one sample on each sidewall (i.e., four) acceptable. In the case of irregularly shaped excavations, where four walls are not readily discernible, divide the total wall area into four segments of approximately equal size. Sidewall samples should be located in accordance with "biases" outlined earlier in Part 1.

TABLE 2	
EXCAVATION SIDEWALL SAMPLES	
Total Area of Sidewalls (sq ft)	*Number of Samples*
< 500	4
500 < 1,000	5
1,000 < 1,500	6
1,500 < 2,000	7
2,000 < 3,000	8
3,000 < 4,000	9
> 4,000	1 sample per 45 lineal feet of sidewall

VERIFYING IN-SITU AND EX-SITU SOIL REMEDIES

The effectiveness of in-situ soil remedies must be verified by three-dimensional random soil sampling. Refer to Attachment 2 for approved statistical sampling strategies. Certain ex-situ remedies, such as bio-piles or above-ground vapor extraction, may be amenable to statistical sampling strategies or batch sampling. Any proposed sampling strategy for in-situ or ex-situ remedies should be pre-approved by the DNR.

SAMPLE ANALYSIS

All test methods and associated target detection levels for cleanup verification must be consistent with those specified in MERA Operational Memorandum #6. Also, MERA Operational Memorandum #13 may be reviewed to evaluate appropriate QA/QC procedures. Generally, constituents in soil will be measured on a total, dry weight basis.

BACKGROUND SOIL SAMPLES

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

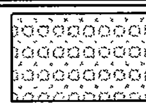
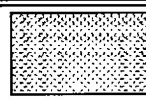
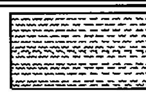
Background should be established as appropriate for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with MERA Operational Memorandum #6

Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface		
Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples
Gray silty CLAY w/trace of fine-med sand		4 samples

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STATISTICAL ANALYSIS FOR ESTABLISHING

BACKGROUND CONCENTRATIONS

The recommended statistical method for establishing background concentrations at small sites is (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations or (2) other statistical methods submitted to DNR for approval.

1. *Mean Plus 3 Standard Deviation Approach*

Calculate the "upper limit" of background concentration by using the following 5 step process.

A. Calculate the background mean (X_b) by dividing the sum of the total background readings by the total number of background readings:

$$X_b=(X_1 + X_2 + ...X_n) / n$$

B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

$$S_b^2 = ((X_1-X_b)^2 + (X_2-X_b)^2 + ...(X_n-X_b)^2) / n\text{-}1$$

NOTE: Any sample populations less than (n<30 samples) must use n - 1 for degrees of freedom

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C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = (S_b^2)^{½}$$

D. The Coefficient of Variation Test (CV) where

$$CV = S_b/X_b$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1. If the data distribution exceeds a CV of 1.0, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, typographical errors, soil classification, sample location, data not normally distributed, etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

E. Use the X_b+ $3*S_b$ of "background" data as the maximum allowable limit or upper limit. Where $3*S_b$ equals three times the standard deviation and X_b equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$X_b \text{ (mean)} = (56 + 25 + 18 + 35) / 4 = 33.5$$

$$S_b^2 = ([56-33.5]^2 + [25-33.5]^2 + [18-33.5]^2 + [35-33.5]^2) / 3 =$$

$$S_b = \text{(standard deviation)} = (S_b^2)^{½} = 16.5$$

$$CV = 16.5/33.5 = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary.

Therefore, the background upper limit value for this site is:

$$X_b + 3*S_b = 33.5 + (3 * 16.5) = 83.0 \text{ ppb}$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

2. *Other statistical procedures for establishing background.* Refer to a statistical reference book or US EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.

2. If more than 50% of the background data is below the detection limit, use one of the following procedures.

- Alternate "0" and the detection limit (DL) resulting in a net value of of the detection limit with a variance.

EXAMPLE:	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

- The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

REPORT FOR SMALL SITE VERIFICATION

Soil cleanup verification reports for small sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(s) and CROSS SECTIONS

Provide a scaled map of the floor and walls of an excavation (the vertical and horizontal area treated for in-situ remediations) with sample locations identified. The cross section should depict the stratigraphy, fractures, soil types, discolorations, unusual characteristics, odor, etc.

2. SAMPLE LOCATION RATIONALE

A. Background sample locations
B. Verification sample locations
C. Sample depths
D. Sample collection procedures
E. Describe biases and rationale used for collecting each sample (e.g., clay fractures, discolored soil, location of leak in tank)

3. DATA ANALYSES

A. Analytical parameters
B. Analytical methods used
C. Method detection limits
D. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES

A. Calculation of background concentrations
B. Coefficient of variance calculations
C. Lab results
D. Narrative explanation of background concentrations

DNR–GUIDANCE DOCUMENT, PART 2

MEDIUM AND LARGE SITE SOIL CLEANUP VERIFICATION

(GREATER THAN 10,890 SQUARE FEET)

Part 2 describes statistical random sampling strategies to verify the remediation of medium and large sites greater than 0.25 acres in size. The strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. The strategies provide a 95% confidence level of determining any hot spot concentrations on a site. It contains guidance on sampling protocol and necessary documentation for clean closures. Part 2 also discusses how to establish grid intervals, set grids, sample grids, statistically evaluate the data, use grids to guide additional remedial activities, disposal options, reporting, and a certification checklist. It also provides guidance on the sampling of ex-situ remedial processes (e.g., thermal desorption).

The term `clean closure' means that the site has been restored to either Type A or Type B levels. Type A is defined in Act 307 P.A. 1982, as amended, which references nondetect or background levels. Type B is defined in Act 307 P.A. 1982, as amended, which references riskbased or background levels. Waste, soil, other environmental media, and/or debris removed should be classified as hazardous or non-hazardous to determine disposal options and handling requirements (i.e., solid waste under Act 641 P.A. 1978, as amended; hazardous waste under Act 64 P.A. 1979, as amended; land ban restrictions under 40 CFR Part 268).

All cleanup verification evaluations must consider the spatial arrangements of sample values (patterned vs totally random) and the impacts on the present and future uses of the site. Because Type B cleanups are based on residual risk, the distribution of that risk, now and in the future, must be determined. These procedures are **not *absolutes***. Other sampling approaches may be developed and submitted for DNR approval.

Three of the statistical sampling strategies most commonly used for evaluating remedial sites and wastes are described in Attachment 2. For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW-846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

Compositing samples for verifying soil remediation is not acceptable without prior DNR approval. When verifying a soil remediation is complete, contaminant concentrations will be low. Compositing may result in the contaminant concentrations not being representative of what remains in the soil. If concentrations are low, compositing may dilute the concentrations of a contaminant to below its threshold detection limit. Additionally, if contamination is indicated in a composited sample, the location of the contamination remains unknown.

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ESTABLISHING GRID INTERVALS

When obtaining samples to verify that soil or wastes have been adequately remediated, it is important to insure that the analytical results obtained will provide an accurate representation of the entire area or volume under consideration. The location and number of samples to be taken at a particular remediation site depends on many factors: the level of confidence desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Such strategies employ the use of gridding to facilitate the unbiased selection of sampling points and accepted statistical tools for evaluating the resultant data. Statistical theory allows for the sampling of a subset of the grid points to achieve a reliable characterization of the entire remedial area or waste. Subsections describe ways to use sampling grids and statistical tools to evaluate areas of remediation.

The following equations and tables provide a simple basis to establish a grid system to facilitate unbiased selection of sampling points and sample coverage proportional to the area being verified.

1. *Basic Strategies.* A grid system should be established over the area being remediated. Grid point representation should be proportional to the size of the area. For excavation, both the sidewalls and bottom areas would be included in the determination of the area size. It is recommended that one of the following equations be used to determine grid intervals for stationing:

small site: see Part 1

medium site: $\mathbf{(A/pi)^{1/2} / 4 = GI}$

large site: $\mathbf{((A*pi) / SF)^{1/2} = GI}$

WHERE: **A = area to be grid (square feet)**

GI = grid interval

SF = Site Factor, length of area to be grid (unitless)

pi = 3.14159

It appears that there are logical size ranges of sites to which the grid equations apply:

A) small: up to 0.25 acre

B) medium: 0.25 3.0 acres

C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

Site Acreage*	***Square Feet****	***~Grid Interval Ranges***
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

* Site acreage, square footage, is total area of sidewalls and base of excavation.

2. ***Setting the Grid.*** After the grid interval is calculated, it is recommended that a scaled grid overlay be

made to superimpose on a map of the remediated area (this area includes both sidewalls and base). Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas. Grid adjustment may also be needed to accommodate a minimum of at least one sample from each sidewall. Proposals for different grid strategies may be submitted for DNR review and approval on a case-by-case basis.

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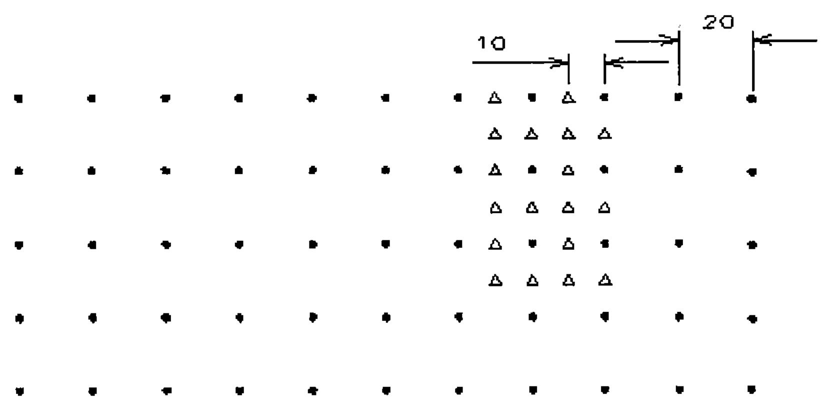
3. ***Variations on Basic Strategy.***

A. Subgridding. It may be warranted to apply grids with different intervals within the remediated area so that a proportional sampling can be focused on suspect areas (such as sumps, tank leak areas, etc.).

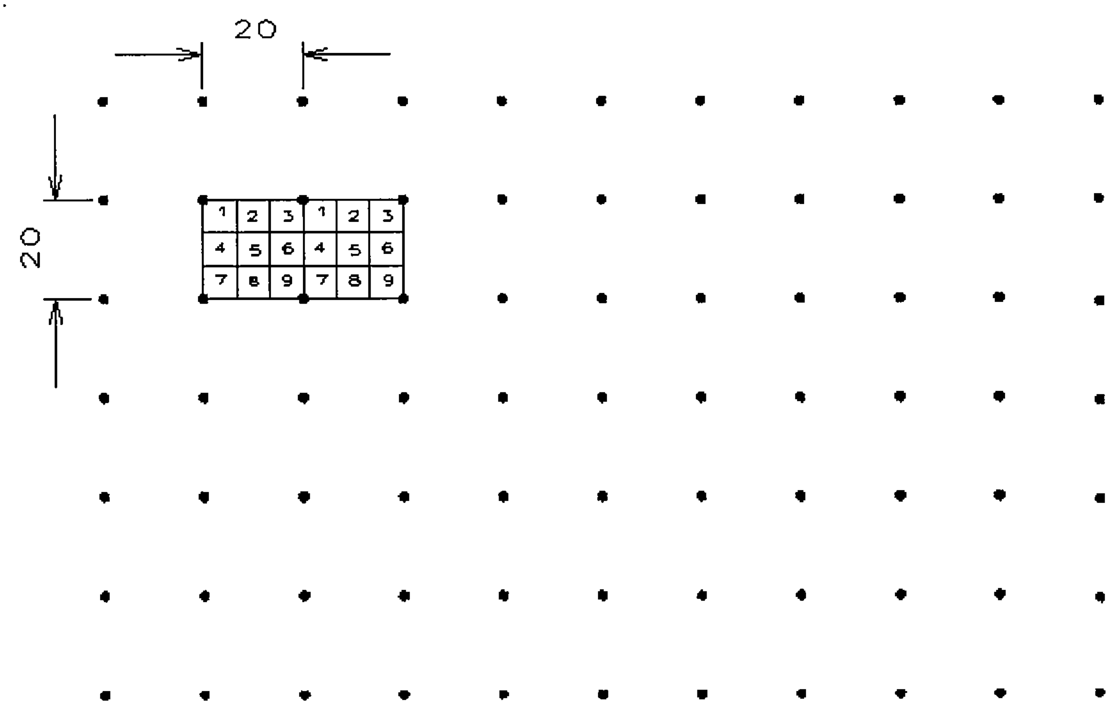


• Area I Sample Station, 80' x 200', GI = 20'

△ Area II (subset of I) Sample Station, 30' x 50', GI = 10'

B. Further Randomization. Sites that may have a patterned distribution of waste or contamination due to time sequence of filling, production sequences, or physical site conditions (i.e., furrows) may require a further randomization of sampling. In such cases, the following grid cell sampling format may be selected instead of at grid point stations. Each grid cell to be sampled must be divided into nine equal sized "subcells." Next, a random number table is used to select in which of the subcells the sample will be taken. The random number table is used again to select which subcell for the next cell and so on.

EXAMPLE:



Area = 120' x 200', GI = 20'

In the example above, a sampling grid has been set up with grid point stations 20 feet apart using the appropriate formula. Two cells which have been selected at random have been divided into nine subcells each. Subcell #4 was chosen randomly in one cell and subcell #2 in the other cell. This process is continued for all of the cells selected at random for sampling. Samples are then taken in each randomly chosen subcell.

C. Three dimensional gridding: In-Situ and Ex-Situ Remediations.

In-situ and ex-situ remediations involving soils and/or wastes with a significant vertical component should be evaluated in three dimensions (volume evaluation). Examples of such remediations would be in-situ soil vapor extraction or ex-situ bioremediation involving several cubic feet of soil and/or waste. A grid is superimposed on the remediation area as described in the previous sections and a vertical component is added at each node. The vertical sampling increments would be site specific and require prior approval from the DNR. Refer to Attachment 1 "Guide to Sample Bias" for additional guidance on vertical sampling increments.

SAMPLING OF GRID

Sampling of grids may include all of the grid stations or a phased subset of the total stations. The subset of grid stations is created by assigning coordinates to all the nodes and randomly selecting nodes using a random number generator or a random number table (refer to Attachment 2). A minimum of 12 samples or 25%, whichever is larger, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for statistical analysis. It is advisable that extra samples also be taken and kept under proper chain of custody and storage procedures at the time of initial sampling. If the statistical analysis indicates that more samples are needed, an additional sample trip to the field may have been avoided. A method for calculating the sample size requirements is presented in Attachment 2 (Lamda relationship).

ESTABLISHING SOIL BACKGROUND

Establishing soil background, as required by Act 307 PA 1982, as amended, Michigan Environmental Response Act (MERA), can be accomplished by utilizing Operational Memorandum #15 or using the following guidance.

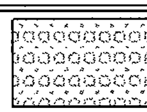
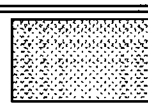
Background should be established for site specific waste constituents, specific chemicals used in various processes, facility operations, or remedial investigation results. Sample analyses may include metals, organic constituents, or other site specific waste constituents. Analyses should be in accordance with Act 307 P.A. 1982, as amended.

Many factors can play a part in the background concentrations of a chemical in soil.

EXAMPLE: The geologic origin (e.g., the parent rock) of glacial drift may have been high in copper, lead, or other metals that may be potential contaminants. Additionally, the hydrogeologic situation can alter the quantity of these elements. Groundwater recharge areas (e.g., highlands) are frequently leached of metals while groundwater discharge areas (e.g., swamps, floodplain) are the recipients of leached metals. Thus, sites in low areas will usually have higher background concentrations than upland areas. Other conditions, such as precipitation and atmospheric fallout from widely dispersed human and natural activities, also affect soil concentrations.

A minimum of four samples must be used to establish "background" in soils. This will help account for natural constituent occurrences and inherent variability within each distinctive soil horizon. Background samples must be collected in an area which has not been impacted by environmental contamination from the site and representative of natural background conditions. Based on waste type, contaminant mobility, operation practices, and soil type (sand, silty sand, clay), an estimate of contamination depth should be made and background samples taken at comparable depths for the particular soil type. Multiple soil horizons should have "background" established separately (e.g., minimum of four samples per each soil unit).

EXAMPLE:

Ground Surface		
Brown medium-coarse SAND		4 samples
Lt. brown silty fine SAND		4 samples

Gray silty CLAY w/trace of fine-med sand		4 samples

STATISTICAL ANALYSIS FOR ESTABLISHING BACKGROUND CONCENTRATIONS

The recommended statistical method(s) for establishing background concentrations at medium and large sites are (1) establishing the upper limit of background concentration of a constituent at the mean plus 3 standard deviations, (2) tolerance limit, (3) t-tests, and (4) other statistical methods submitted to the DNR for approval.

1. *Mean Plus 3 Standard Deviation Approach*

Calculate the "upper limit" of background concentration by using the following 5 step process.

A. Calculate the background mean (X_b) by dividing the sum of the total background readings by the total number of background readings:

$$\mathbf{X}_b = (\mathbf{X}_1 + \mathbf{X}_2 + \ldots \mathbf{X}_n) \,/\, n$$

B. Calculate the background variance (S_b^2) by taking the sum of the squares of each reading minus the mean and dividing by the degrees of freedom (the total number of background samples minus one):

$$S_b^2 = ((X_1 - X_b)^2 + (X_2 - X_b)^2 + \ldots (X_n - X_b)^2) \,/\, n-1$$

NOTE: Any sample populations less than (n<30 samples) must use n - 1 for degrees of freedom

C. Calculate the background standard deviation (S_b) by taking the square root of the variance:

$$S_b = (S_b^2)^{1/2}$$

D. The Coefficient of Variation Test (CV) where

$$\mathbf{CV} = S_b / X_b$$

is used to evaluate data distribution. The background data should generally have a CV of less than 0.5 for granular soils, less than 0.75 for cohesive soils, or an explanation accounting for higher CV values. The maximum recommended CV is 1. If the data distribution exceeds a CV of 1.0, then a thorough evaluation will need to be made to account for this variability (e.g., lab QA/QC, typographical errors, soil classification, sample location, data not normally distributed, etc.). If the CV exceeds 1.0 and there is sufficient evidence to suggest a data point does not accurately represent background conditions or if QA/QC problems exist which invalidate that data point, the outlier data may be dropped or additional samples collected and analyzed to ensure a sufficient representative data population (n) is achieved. A high concentration in and of itself is not sufficient justification to exclude the data point.

E. Use the $\mathbf{X_b + 3*S_b}$ of "background" data as the maximum allowable limit or upper limit. Where $\mathbf{3*S_b}$ equals three times the standard deviation and $\mathbf{X_b}$ equals the background mean (this statistical method only requires one sample per station). Compare each sample point to the calculated maximum allowable limit or upper limit analyzed from background data.

EXAMPLE: Four sand samples from a site were analyzed for background concentrations for lead. Concentrations of lead from the sample analyses returned from the lab were 56, 25, 18, and 35 ppb. Now, the investigator wants to examine the data set to discover whether the 56 ppb sample is an outlier:

$$X_b \text{ (mean)} = (56 + 25 + 18 + 35) / 4 = 33.5$$

$$S_b^2 = ([56-33.5]^2 + [25-33.5]^2 + [18-33.5]^2 + [35-33.5]^2) / 3 =$$

$$S_b = \text{(standard deviation)} = (S_b^2)^{½} = 16.5$$

$$CV = 16.5/33.5 = 0.49$$

Because 0.49 is less than 0.5, no further evaluation of the background data set is necessary. Therefore, the background upper limit value for this site is:

$$X_b + 3*S_b = 33.5 + (3 * 16.5) = 83.0 \text{ ppb}$$

If a value is found to be an outlier which is not representative of background conditions, it may be replaced by another sample that is not an outlier to maintain at least four samples for background determination.

2. *Tolerance Limit.* This statistical procedure is a fairly sensitive program for environmental purposes. It minimizes false positive and is simple to perform. **A minimum background data base of n=8** (optimum n=16) is needed for this method. Other suggested criteria follow:

A. The Coefficient of Variation Test (CV) to evaluate data distribution. See this Guidance Document, Part 2, Statistical Analysis for Establishing Background Concentrations, #1.D. (the Coefficient of Variation Test....).

B. Using the mean (X_b) and standard deviation (S_b), construct the onesided upper tolerance limit (TL) by taking the mean plus a tolerance coefficient (K) at the 95% probability level for a 95% coverage (for

K values, see Attachment 3) times the standard deviation as follows:

$$TL = X_b + KS_b$$

---

3. *ttests.* Any ttest should be "approved" by DNR prior to use since there are a number of variations. The Gosset Student ttest (1908) or Cochran's Approximation to the Behren'sFisher Student's ttest as referenced in the 40 CFR Part 264, Appendix IV, are recommended. **Note** that these statistical comparison methods require that two or more discrete samples be taken at each sampling station.

4. *Other statistical procedures for establishing background.* Refer to a statistical reference book or US EPA's Interim Final Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities (April 1989) and Addendum (July 1992).

PROCEDURES FOR NON-DETECT VALUES

The following provides some guidelines in incorporating non-detectable sample results into the procedure to calculate background concentrations.

1. If less than 50% of the background data is below the detection limit (DL), use ½ of the detection limit as the value.

2. If more than 50% of the background data is below the detection limit, use one of the following procedures.

- Alternate "0" and the detection limit (DL) resulting in a net value of of the detection limit, with a variance

EXAMPLE:	Actual Value	Substitute Value
	<DL	DL
	<DL	0
	<DL	DL
	<DL	0

- The Continuity Correction procedure with the t-test, Cohen's method, or other approved methods.

STATISTICAL EVALUATION OF DATA

A detailed description of an acceptable approach for evaluating the data generated by statistically based random sampling strategies such as those described in the foregoing sections is provided in Attachment 2 (page 29). The 95% upper confidence limit (UCL) of the mean is calculated for each constituent of concern and compared to the regulatory threshold (RT) (i.e., cleanup criterion; e.g., Type A or B). If the

UCL is less than the RT and an adequate number of samples have been collected and spatially evaluated, the remediation is deemed complete. Attachment 2 also provides a step wise procedure for determining whether an adequate number of samples have been collected, based on the analytical data derived from the initial and subsequent rounds of samples. **All evaluations must consider the spatial correlation of sample values** (e.g., highest concentrations in the same area), **present and future uses of the site, residual risk, and distribution of that risk now and in the future.** Other acceptable methods for UCL and sample size calculations can be found in US EPA SW-846, Third Edition, Section 9.1.1.3.

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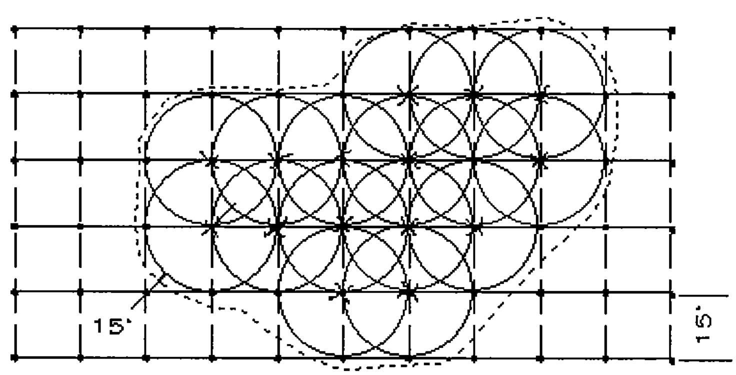
GRID APPROACH TO ADDITIONAL REMEDIATION

1. *TwoDimensional Node Sampling Excavation Grid.* Verification sampling as described above will at times indicate that remediation is incomplete. Excavation of contaminated areas should be based on the established grid system interval (as recommended in this Guidance Document, Part 2). Where a subset of grid points has indicated that the entire area exceeds the cleanup, the nodes adjacent to the sampled nodes that are causing the exceedance should be sampled, and this process repeated until the "Hot spots" requiring removal have been defined. The radius of excavation around the contaminated sample point(s) is equal to the grid interval (GI=r). Excavation depth is to the deepest point of contamination or to the depth where acceptable levels are anticipated. After excavation, the impacted point(s) must be resampled at their new elevations to verify that the area meets the selected cleanup criteria. If continued contamination is detected, the excavation format is repeated until a satisfactory result is obtained.

EXAMPLE:



GL = 150
A = 11,250
GI = 14.9

· Sample Station
x Contaminated Station
r = GI = 15 feet

Remediation of contaminated soil by excavation will be in accordance with Act 307 P.A. 1982, as amended. The proposed remedial action plan must be approved by the DNR.

2. *Two-Dimensional Subcell Sampling Excavation Grid*. Use this Guidance Document, Part 2. The radius of excavation around a contaminated point may need to be adjusted to greater than the GI distance. This adjustment is due to the variable distances between sampling points.

3. *ThreeDimensional Cleanup Verification*. If sampling and statistical analysis using this Guidance Document indicate that Act 307 cleanup criteria have not been met, additional remediation will be required. The sampling protocol and strategies described in Attachment 2 and in SW-846, Third Edition, Volume II, Part III, Chapter 9, are acceptable. All sampling strategies, detection levels, and sampling pathways must be in accordance with Act 307 P.A. 1982, as amended. If any portion of the soil mass in question appears to be causing the material to fail, it may be identified through hot spot sampling and selectively removed. Subsequent sampling must be done to confirm that the remaining material meets Act 307 P.A. 1982, as amended.

4. *Batch Sampling for exsitu treatment processes.* If exsitu treatment processes of contaminated soil or waste is used in the remediation, a sampling program for the process stream needs to be developed. The basis of this program is to get representative samples over time versus a spatial approach (Attachment 2, Sampling Process Streams).

DISPOSAL OPTIONS

Soils remediated to Act 307 P.A. 1982, as amended, standards (Type A and/or Type B) are no longer considered a waste per Act 64 P.A. of 1979, as amended, and RCRA regulations. Disposal of excavated waste, soil, other environmental media, and/or debris must be in accordance with all applicable Federal, State, and local regulations.

REPORT FOR MEDIUM AND LARGE SITES VERIFICATION

Soil cleanup verification reports for medium and large sites must identify the number and location of samples and justify the sample location selected (why and how). The verification report must include the following.

1. MAP(S) AND CROSS SECTIONS

Provide a scaled map of the floor and walls of the excavation (the vertical and horizontal area treated for in-situ remediations) with sample grid and sample locations identified. Appropriate cross section should depict the stratigraphy, fractures, soil types, and final depth and elevations of the excavation.

2. SAMPLE LOCATION RATIONALE

a. Properly labeled and easily identified sampling grid stations (map) including background stations
b. Sample Depths

c. Sample Collection Procedures
d. Results of all tests to determine clean closure (charts, tables, lab sheets, field notes, well logs, boring logs)

3. DATA ANALYSES

a. Analytical parameters
b. Analytical methods used
c. Method detection limits
d. Laboratory Quality Assurance/Quality Control

4. STATISTICAL ANALYSES

a. Explanation and calculation of background concentrations
b. Statistical comparisons on sampling results compared to background (this should include full computations on background and statistical analysis)
c. Lab results

5. Additional information to support closure (e.g., residual risks, spatial correlation of sample values, present and future land uses).

RCRA CLEAN CLOSURE CERTIFICATION CHECKLIST

Attachment 4 is a guide that indicates the information that a facility should provide to certify that their activities meet the conditions for a clean closure under the Act 64/RCRA regulations.

ATTACHMENT 1

GUIDE TO SAMPLE BIAS

Many factors can play a part in the concentrations of contaminants. The following contains some of the factors impacting chemical concentrations and locations.

CHEMICAL TRANSFORMATIONS

Many organic chemicals may undergo aerobic and anaerobic degradation. A description of these processes is beyond the scope of this document. The subject is approached here, however, to be sure that samplers are aware that the chemical(s) spilled may not be the only chemical(s) in the soil after a transformation has occurred. These occurrences should be documented in the remedial investigation. The full scan of chemicals from the remedial investigation requiring cleanup should be analyzed when doing a closure. Analyses should be done for all chemicals that have been identified as breakdown products of the chemicals found on-site.

The professional literature contains many articles on this subject (Cline and Brown, 1989; Borden and Bedient, 1987; Wilson and Wilson, 1985). The interested reader is directed to these articles.

Organic Carbon Content of Soil
The organic carbon content of soils is a key factor in the ability of any soil to adsorb contaminants. For a variety of reasons (Lindsay, 1979), an increase in organic carbon content leads to an increase in the adsorption of several classes of chemicals.

> **Where to sample**: Areas of the excavation that appear to have excess organic carbon (e.g. peat, muck, darker soils) should be preferentially sampled.

Medium Sand or Larger Grains
Medium to larger grain size sand has from 20 to 40 percent porosity. Most sands in Michigan are composed of quartz, limestone, and small amounts of metamorphic rock fragments. These soils have a low capacity for adsorbing metals or hydrophilic (soluble) organic chemicals. Hydrophobic (insoluble) organic chemicals with low molecular weight will adsorb to this soil in small amounts. Hydrophobic chemicals with high molecular weight will adsorb in moderate amounts (Cline & Brown, 1989). These soils have a low capacity to hold contaminants in the grain interstices due to low capillary action. Contaminants that are held in these soils adhere to the grains themselves in dry soils and are forced into the smaller pore spaces in wet soils (Schwille, 1988).

> **Where to sample**: Samples should be placed at regular intervals along the base and sidewalls of the excavation being sure that samples are located where the source was removed. In these soils, the capillary force is low enough to ignore its effects in transporting contaminants lateral to gravity. Therefore, sidewall samples should be located near the excavation floor. This is especially true for low surface tension products such as gasoline.
>
> The limestone sand grains can act as a buffer to contaminants that cause pH changes (e.g., steel mill pickling acids). For these types of contaminants, the sampler should be on the lookout for intra-granular precipitates. These can appear as grain surface staining or make the soil appear clumpy or aggregated. Soils containing precipitates should be sampled.

Fine Sand and Silt

These soils have strong capillary action due to the small inter-granular distances. A determination of the fluid surface tension of the spilled product is helpful. High surface tension aids in the ability of a substance to overcome gravity by capillary action. As before, higher molecular weight products can be expected to adsorb to the grains to a greater degree. This allows a product to move lateral to gravity and, to a degree, upward from the leak location. Low surface tension products, such as TCE (trichloroethene), are more likely to go straight down than oils in these kinds of soils. However, the hydraulic head (i.e., the amount of product in the original spill) must be substantial to force a dense non-aqueous phase liquid through a media with a hydraulic
conductivity less than 1 x 10-3 cm/sec (Schwille, 1988).

> **Where to sample:** Interfaces between fine sand layers with larger grains above should be sampled. When high surface tension contaminants are suspected, silt layers should be sampled.

Clays

Clay soils are very different from the sands and silts. Clays possess a net negative charge. This causes heavy metal cations (e.g., Cr^{+6}, Cd^{+2}, Pb^{+2}) to adsorb to the clay surface. In fact, this is true for any positive ionizable substance. Clays also have a much greater secondary porosity than primary (primary porosity is the space between the soil particles; secondary porosity is the space between fractures, bedding planes, and soil structures). As a result, spills in clay soils tend to follow preferred pathways. Clays will often show signs of shrinkage cracks or fractures that will allow contaminants to migrate in what would otherwise be considered a "tight" soil in a lab analysis of permeability. Signs of fracturing include "patterned" mottling. This is where the Fe (and also Mn) will be oxidized to a red, yellow, or reddish brown color along the crack while the matrix remains the reduced blue/gray color (Lindsay, 1979).

> **Where to sample:** It is very important to take clay soil samples from fractures. The fractures are the avenue of travel for contaminants in clay soils. Clay soils may also have sand lenses which should always be sampled. Sand lenses in clays tend to collect fluids. As such, they may harbor contaminants.

Bedrock

Excavations in bedrock present difficult problems. Unlike clay, some bedrock formations have substantial primary porosity as well as secondary porosity. In Michigan, these are sandstones, conglomerates, and brecciated/coarse grained limestones. Examples of bedrock in Michigan with low primary porosity are fine grained limestones, shale, and crystalline metamorphic rocks (e.g., gneiss). If the sampler is unaware of the type of bedrock that is in an excavation, a geologist must be consulted.

> **Where to sample:** Excavations in areas of bedrock with significant primary porosity must be sampled in both the fractures and the matrix. Bedrock without primary porosity should have sampling predominantly in the fractures as in the clay situation. Weathered zones in bedrock will hold contaminants better than unweathered zones. This is due to the increased number of adsorption sites available in weathered rock.

ATTACHMENT 2

SAMPLING PROTOCOL
FOR CHARACTERIZING WASTE/TREATMENT LEVELS:

STRATEGIES FOR EVALUATING TREATED SOILS AND WASTE MATERIALS

When obtaining samples to characterize a treated soil or waste material, it is important to insure that the analytical results obtained will provide an accurate estimation of the nature of the entire area/volume under consideration. The location and number of samples to be taken at a particular site depend on many factors: the degree of accuracy desired, the spatial and temporal variability of the media to be sampled, and the costs involved. An important objective in any sampling program is to obtain the most accurate data possible while minimizing the associated costs. One method to accomplish this goal is to use statistically valid sampling strategies. The appropriate sample number can be estimated and the sampling locations can be chosen without bias.

Attachment 2 provides information on the methods used to obtain accurate data while minimizing the costs. The attachments include a discussion of three statistical sampling strategies and methods to determine the appropriate grid size for the area under investigation. If several areas on a site are under investigation, it may be advisable to grid them separately. This is especially true if information does not exist to indicate that the areas contain similar constituents or that they were placed at the same time period.

Information is also supplied on the statistical evaluation of the resultant analytical data. A minimum of 12 samples or 25%, whichever is greater, of the total grid stations should be sampled and analyzed initially to allow a large enough data pool for the statistical analysis. Extra samples should be taken and kept under proper chain of custody and handling procedures at the time of initial sampling. If the statistical analysis indicates that two or three more samples are needed, an additional trip to the field may not be necessary. This may also avoid the need to reestablish the grid pattern at a later date.

For further discussion on sampling strategies and sample collection methods, see "Test Methods for Evaluating Solid Waste," SW846 Volume II: Field Methods, November 1986, Third Edition, US EPA.

STATISTICAL SAMPLING STRATEGIES

Statistical sampling strategies can often produce increased data accuracy while eliminating sampler bias. Random sampling is based on the theory of random chance probabilities in order to choose the most representative sample. Knowledge of the waste distribution is not necessary. The error in data accuracy of a random sampling scheme can be objectively measured since the probability of choosing each sampling point is known. A random numbers table (attached) or a random numbers generator should be used to select the sampling locations eliminating bias by the sample collector.

Several statistical sampling strategies are available to produce an unbiased, representative sampling program. The principles behind three of these and the situations for which they are best suited are provided below. To achieve true random sampling, composite sampling is not acceptable.

1. ***Simple Random*** is a method that requires little or no prior knowledge of material distribution. It relies on random chance probability theory--where each sampling location has an equal and known probability of being selected. In this way, sampling error can be accurately estimated. Usually, the area of interest is sectioned into a two or three dimensional grid pattern and random coordinates are chosen for sampling.

2. ***Systematic random*** is an extension of simple random sampling that may produce a more efficient sampling survey. It can be more efficient by reducing the sampling error while maintaining the sample number, or by reducing the number of samples needed to achieve a specified sampling error, or by reducing the cost of collection. This method also requires little or no knowledge about the waste distribution, but bias and imprecision can be introduced if unseen trends or cycles exist. Two methods used to select sample locations

under this method follow.

A) randomly selecting a transect or transects and sampling at preselected intervals

B) preselecting both the transect or transects and the sampling interval and starting from a randomly selected point.

3. ***Stratified random sampling*** requires some knowledge about the waste distribution. When stratification is known or suspected, sampling efficiency can be improved by dividing the material into strata that are more homogeneous than the total area. Simple random sampling techniques can then be used to sample each stratum independently. Each stratum is divided into a grid pattern and the sampling points are selected randomly. If the area is vertically stratified, the sampling points in each stratum are selected randomly and then selected depths are sampled. If the area is horizontally stratified, the sampling points within each stratum are selected randomly, but the total depth is sampled. An analysis of variance (ANOVA) should be done on the analytical results to determine if the strata differ significantly. This is done to assure that the use of stratified random sampling was statistically valid. When the volume of the strata differ or the number of samples within each strata differs, the results must be weighed appropriately to avoid bias.

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RANDOM NUMBERS TABLE

HOW TO USE THE RANDOM NUMBERS TABLE

1. Determine the number of samples you need to take. Identify the number of digits necessary to cover the sample population (e.g., for a sample population of 55, two digits are necessary to cover the selected grid stations 01 through 55).

2. Using the random numbers table, choose any number as a starting point.

3. From this starting point number, go in any direction and continue in the same direction and pattern sequence until you have selected the predetermined number of samples with no repetitions. Numbers larger than the population size are ineligible (e.g., numbers greater than 55 in the example are ineligible).

Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	10480	15011	01536	02011	81647	91646	69179	14194	62590	36207
2	22368	46573	25595	85393	30995	89198	27982	53402	93965	34095
3	24130	48360	22527	97265	76393	64809	15179	24830	49340	32081
4	42167	93093	06243	61680	07856	16376	39440	53537	71341	57004
5	37570	39975	81837	16656	06121	91782	60468	81305	49684	60672
6	77921	06907	11008	42751	27756	53498	18602	70659	90655	15053

7	99562	72905	56420	69994	98872	31016	71194	18738	44013	48840
8	96301	91977	05463	07972	18876	20922	94595	56869	69014	60045
9	89579	14342	63661	10281	17453	18103	57740	84378	25331	12566
10	85475	36857	43342	53988	53060	59533	38867	62300	08158	17983
11	28918	69578	88231	33276	70997	79936	56865	05859	90106	31595
12	63553	40961	48235	03427	49626	69445	18663	72695	52180	20847
13	09429	93969	52636	92737	88974	33488	36320	17617	30015	08272
14	10365	61129	87529	85689	48237	52267	67689	93394	01511	26358
15	07119	97336	71048	08178	77233	13916	47564	81056	97735	85977
16	51085	12765	51821	51259	77452	16308	60756	92144	49442	53900
17	02368	21382	52404	60268	89368	19885	55322	44819	01188	65255
18	01011	54092	33362	94904	31273	04146	18594	29852	71585	85030
19	52162	53916	46369	58586	23216	14513	83149	98736	23495	64350
20	07056	97628	33787	09998	42698	06691	76988	13602	51851	46104
21	48663	91245	85828	14346	09172	30168	90229	04734	59193	22178
22	54164	58492	22421	74103	47070	25306	76468	26384	58151	06646
23	32639	32363	05597	24200	13363	38005	94342	28728	35806	06912
24	29334	27001	87637	87308	58731	00256	45834	15398	46557	41135
25	02488	33062	28834	07351	19731	92420	60952	61280	50001	67658
Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
26	81525	72295	04839	96423	24878	82651	66566	14778	76797	14780
27	29676	20591	68086	26432	46901	20849	89768	81536	86645	12659
28	00742	57392	39064	66432	84673	40027	32832	61362	98947	96067
29	05366	04213	25669	26422	44407	44048	37937	63904	45766	66134
30	91921	26418	64117	94305	26766	25940	39972	22209	71500	64568
31	00582	04711	87917	77341	42206	35126	74087	99547	81817	42607
32	00725	69884	62797	56170	86324	88072	76222	36086	84637	93161
33	69011	65797	95876	55293	18988	27354	26575	08625	40801	59920
34	25976	57948	29888	88604	67917	48708	18912	82271	65424	69774
35	09763	83473	73577	12908	30883	18317	28290	35797	05998	41688
36	91567	42595	27958	30134	04024	86385	29880	99730	55536	84855
37	17955	56349	90999	49127	20044	59931	06115	20542	18059	02008
38	46503	18584	18845	49618	02304	51038	20655	58727	28168	15475
39	92157	89634	94824	78171	84610	82834	09922	25417	44137	48413
40	14577	62765	35605	81263	39667	47358	56873	56307	61607	49518
41	98427	07523	33362	64270	01638	92477	66969	98420	04880	45585
42	34914	63976	88720	82765	34476	17032	87589	40836	32427	70002
43	70060	28277	39475	46473	23219	53416	94970	25832	69975	94884
44	53976	54914	06990	67245	68350	82948	11398	42878	80287	88267
45	76072	29515	40980	07391	58745	25774	22987	80059	39911	96189
46	90725	52210	83974	29992	65831	38857	50490	83765	55657	14361
47	64364	67412	33339	31926	14883	24413	59744	92351	97473	89286
48	08962	00358	31662	25388	61642	34072	81249	35648	56891	69352
49	95012	68379	93526	70765	10593	04542	76463	54328	02349	17247
50	15664	10493	20492	38391	91132	21999	59516	81652	27195	48223
51	16408	81899	04153	53381	79401	21438	83035	92350	36693	31238
52	18629	81953	05520	91962	04739	13092	97662	24822	94730	06496
53	73115	35101	47498	87637	99016	71060	88824	71013	18735	20286
54	57491	16703	23167	49323	45021	33132	12544	41035	80780	45393
55	30405	83946	23792	14422	15059	45799	22716	19792	09983	74353
56	16631	35006	85900	98275	32388	52390	16815	69298	82732	38480
57	96773	20206	42559	78985	05300	22164	24369	54224	35083	19687
58	38935	64202	14349	82674	66523	44133	00697	35552	35970	19124
59	31624	76384	17403	53363	44167	64486	64758	75366	76554	31601

60	78919	19474	23632	27889	47914	02584	37680	20801	72152	39339
61	03931	33309	57047	74211	63445	17361	62825	39908	05607	91284
62	74426	33278	43972	10119	89917	15665	52872	73823	73144	88662
63	09066	00903	20795	95452	92648	45454	09552	88815	16553	51125
64	42238	12426	87025	14267	20979	04508	64535	31355	86064	29472
65	16153	08002	26504	41744	81959	65642	74240	56302	00033	67107
66	21457	40742	29820	96783	29400	21840	15035	34537	33310	06116
67	21581	57802	02050	89728	17937	37621	47075	42080	97403	48626
68	55612	78095	83197	33732	05810	24813	86902	60397	16489	03264
69	44657	66999	99324	51281	84463	60563	79312	93454	68876	25471
70	91340	84979	46949	81973	37949	61023	43997	15263	80644	43942
71	91227	21199	31935	27022	84067	05462	35216	14486	29891	68607
72	50001	38140	66321	19924	72163	09538	12151	06878	91903	18749
73	65390	05224	72958	28609	81406	39147	25549	48542	42627	45233
74	27504	96131	83944	41575	10573	08619	64482	73923	36152	05184
75	37169	94851	39117	89632	00959	16487	65536	49071	39782	17095
Line/Col.	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
76	11508	70225	51111	38351	19444	66499	71945	05422	13442	78675
77	37449	30362	06694	54690	04052	53115	62757	95348	78662	11163
78	46515	70331	85922	38329	57015	15765	97161	17869	45349	61796
79	30986	81223	42416	58353	21532	30502	32305	86482	05174	07901
80	63798	64995	46583	09765	44160	78128	83991	42865	92520	83531
81	82486	84846	99254	67632	43218	50076	21361	64816	51202	88124
82	21885	32906	92431	09060	64297	51674	64126	62570	26123	05155
83	60336	98782	07408	53458	13564	59089	26445	29789	85205	41001
84	43937	46891	24010	25560	86355	33941	25786	54990	71899	15475
85	97656	63175	89303	16275	07100	92063	21942	18611	47348	20203
86	03299	01221	05418	38982	55758	92237	26759	86367	21216	98442
87	79626	06486	03574	17668	07785	76020	79924	25651	83325	88428
88	85636	68335	47539	03129	65651	11977	02510	26113	99447	68645
89	18039	14367	61337	06177	12143	46609	32989	74014	64708	00533
90	08362	15656	60627	36478	65648	16764	53412	09013	07832	41574
91	79556	29068	04142	16268	15387	12856	66227	38358	22478	73373
92	92608	82674	27072	32534	17075	27698	98204	63863	11951	34648
93	23982	25835	40055	67006	12293	02753	14827	22235	35071	99704
94	09915	96306	05908	97901	28395	14186	00821	80703	70426	75647
95	50937	33300	26695	62247	69927	76123	50842	43834	86654	70959
96	42488	78077	69882	61657	34136	79180	97526	43092	04098	73571
97	46764	86273	63003	93017	31204	36692	40202	35275	57306	55543
98	03237	45430	55417	63282	90816	17349	88298	90183	36600	78406
99	86591	81482	52667	61583	14972	90053	89534	76036	49199	43716
100	38534	01715	94964	87288	65680	43772	39560	12918	86537	62738
101	13284	16834	74151	92027	24670	36665	00770	22878	02179	51602
102	21224	00370	30420	03883	96648	89428	41583	17564	27395	63904
103	99052	47887	81085	64933	66279	80432	65793	83287	34142	13241
104	00199	50993	98603	38452	87890	94624	69721	57484	67501	77638
105	60578	06483	28733	37867	07936	98710	98539	27186	31237	80612
106	91240	18312	17441	01929	18163	69201	31211	54288	39296	37318
107	97458	14229	12063	59611	32249	90466	33216	19358	02591	54263
108	35249	38646	34475	72417	60514	69257	12489	51924	86871	92446
109	38980	46600	11759	11900	46743	27860	77940	39298	97838	95145
110	10750	52745	38749	87365	58959	53731	89295	59062	39404	13198
111	36247	27850	73958	20673	37800	63835	71051	84724	52492	22342
112	70994	66986	99744	72438	01174	42159	11392	20724	54322	36923

113	99638	94702	11463	18148	81386	80431	90628	52506	02016	85151
114	72055	15774	43857	99805	10419	76939	25993	03544	21560	83471
115	24038	65541	85788	55835	38835	59399	13790	35112	01324	39520
116	74976	14631	35908	28221	39470	91548	12854	30166	09073	75887
117	35553	71628	70189	26436	63407	91178	90348	55359	80392	41012
118	35676	12797	51434	82976	42010	26344	92920	92155	58807	54644
119	74815	67523	72985	23183	02446	63594	98924	20633	58842	85961
120	45246	88048	65173	50989	91060	89894	36063	32819	68559	99221
121	76509	47069	86378	41797	11910	49672	88575	97966	32466	10083
122	19689	90332	04315	21358	97248	11188	39062	63312	52496	07349
123	42751	35318	97513	61537	54955	08159	00337	80778	27507	95478
124	11946	22681	45045	13964	57517	59419	58045	44067	58716	58840
125	96518	48688	20996	11090	48396	57177	83867	86464	14342	21545

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SAMPLING GRIDS

1. A grid system should be established over the specified area (sidewalls and base). Grid point representation should be proportioned to the size of the area. It is recommended that one of the following equations be used to determine grid intervals for stationing.

----

small site: $(A/pi)^{1/2} / 2 = GI$

medium site: $(A/pi)^{1/2} / 4 = GI$

large site: $((A*pi) / SF)^{1/2} = GI$

WHERE: A = area to be grid (square feet)

GI = grid interval

SF = Site Factor, length of area to be gridded (unitless)

pi = 3.14159

It appears that there are logical size ranges of sites to which the grid equations apply:

A) small: up to 0.25 acre

B) medium: 0.25 3.0 acres

C) large: 3.0 acres and greater

To simplify this application, use the following chart based on an average size range of sites (1 acre = 43,560 square feet). The approximate grid ranges are provided as a quick check on numbers generated for specific sites using the above formulas.

*Site Acreage**	*Square Feet**	*~Grid Interval Ranges*
up to 0.25 (small)	up to 10,890	See Part 1
0.25-3.00 (medium)	10,890-130,680	15-50 feet
3.0 and over (large)	130,680 +	30 feet plus

* Site acreage, square footage, is total area of sidewalls and base of excavati

2. After the grid interval is calculated, it is recommended that a scaled grid overlay be made to superimpose on the area under consideration. Some specified point (usually the southwest corner) should be designated as the 0,0 coordinate. The grid can then be adjusted to maximize sampling coverage. Some grid adjustment may be necessary for unusually shaped areas.

STATISTICAL EVALUATION WASTE/TREATMENT CHARACTERIZATION SAMPLINGS

Following is a step by step description of the approach used to calculate confidence limits based on the analytical data derived from the preliminary samples.

1. Calculate a preliminary estimate of the mean, *X*

$$X = (X_1 + X_2 + X_3 + \ldots X_n) / n$$

where:

n = number of measurements
X = variable concentration
Xi = individual measurements

2. Calculate a preliminary estimate of the variance (S^2) and the standard deviation (S). Standard deviation is a function of both sampling variability and measurement variability.

$$S^2 = [(X_1 - X)^2 + (X_2 - X)^2 + \ldots (X_n - X)^2] / n-1$$

$$S = (S^2)^{1/2}$$

3. Calculate the standard error of the mean (Sx). Standard error is inversely proportional to the square root of the number of samples (increasing n from 4 to 16 reduces Sx by 50%).

$$Sx = S / (n)^{1/2}$$

4. Since the concern is only whether the upper limit of a confidence interval is below or above the regulatory threshold, the lower confidence limit (LCL) need not be considered. The upper confidence limit (UCL) can be calculated using the onetailed (onesided) t values with n1 degrees of freedom derived from a table of the Student's t distribution. Where only small sized statistical samples are involved (n<30), the normal or Gaussian distribution is not accurate, and the t distribution must be used.

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5. The 95% UCL is calculated by using the following formula and substituting the values determined above plus the appropriate t value obtained from the t table.

$$UCL = X + [t_{0.95,(n-1)}]*Sx$$

The term in brackets indicates a one-tailed t-test at n-1 degrees of freedom. See the t-distribution table in Attachment 2.

The UCL number resulting from this formula will indicate with a 95% probability that it is either above or below the regulatory threshold (RT) developed for the constituent being subjected to the test. If a compound does not have a specified RT, then the UCL is compared to whatever concentration is of concern (i.e., a clean up level, action level, etc). Other confidence levels can be used, based on the specific sampling situation.

If the preliminary data indicate that more samples are needed to make a hazard determination, the Lambda relationship should be used. A step by step approach to calculating the appropriate sample size follows:

1. The appropriate number of samples to be collected can be estimated by use of the Lambda relationship and then consulting a table of values and their corresponding sample size number.

$$Lambda = (RT - X) / S$$

The lower the calculated value, the more samples are required to maintain a certain level of confidence. Also, as approaches RT, Lambda becomes smaller, and therefore a greater sample size is indicated for a certain level of confidence.

2. To obtain the appropriate sample size from the table of values, use the single sided value for to test at the desired significance level (for 5%, = 0.05).

3. Randomly collect any additional samples that may be needed using the same grid and random numbers sequence as the first sampling. All field and laboratory procedures should be kept as consistent as possible to lower the amount of variability in the data.

4. Use all data values to calculate new X, S, and Sx.

5. If the new $X \geq RT$, then the contaminant is present at an unacceptable concentration and the study would be complete.

6. If $X < RT$ and $X > S^2$, calculate C (the criterion for determining if contamination is present at hazardous concentration). If $X = S^2$ or $X < S^2$, the data must be transformed prior to calculating C. Using the new data, C is calculated by the formula:

$$C = (RT - X) / Sx$$

7. Compare the calculated C value to the twotailed t value for the level of significance desired. The two-tailed t-value is used because both the possibility that C is > t or that C is < t must be checked.

Use $t_{0.95}$ and df (degrees of freedom) = n-1.

8. If C > t value, the contaminant is present at unacceptable concentrations and the study would be over. If C < t value, reestimate the total number of additional samples to be collected by deriving a new Lambda. Use the newly calculated values of X and S.

9. If this new number of samples is not more than 20% greater than the last set collected, there is little chance that additional samples would decrease Sx and result in the material being considered unacceptable. Therefore, the study would be complete.

EXAMPLE

CALCULATION OF CONFIDENCE LIMITS AND LAMDA CALCULATION

Problem 1: STATISTICAL SAMPLING

A metal plating factory has been discharging process wastewaters into a large nearby swampy area for several years. This swampy area drains into a small river. The discharged wastewaters are known to be contaminated with very low levels of cadmium and chromium (i.e., the levels in the wastewater are below the facilities NPDES permit limitations). However, it has been suspected that the sediments in this swampy area may contain high levels of cadmium and chromium. Three preliminary sediment samples were taken with a Ponar dredge and analyzed to determine whether or not these sediments were contaminated with hazardous levels of these two metals. In 40 CFR 261.24, it states that a waste is hazardous under the characteristic of EP toxicity if it contains cadmium at a level ≥1.0 mg/l or chromium at a level ≥5.0 mg/l. The analysis of the three preliminary samples indicated a mean cadmium concentration of 0.37 mg/l (3 samples at 0.25, 0.51, and 0.35 mg/l) and a mean chromium concentration of 4.66 mg/l (3 samples at 4.93, 4.21, and 4.84 mg/l). Based on this analytical data, the cadmium level is well below the regulatory threshold (RT), but the chromium level closely approaches its RT. Because large legal or monetary losses may be incurred if the sediments are declared hazardous, the analytical data must be sound and a high degree of confidence is necessary in any decision made.

QUESTIONS: Given the above scenario, answer the following questions and calculate the appropriate answers.

1. Based on the chromium data supplied

Calculate S^2, S, Sx

Calculate the 95% UCL

With what degree of confidence can it be stated that the chromium concentration does not exceed the RT?

2. If more samples are deemed necessary, determine how many

Calculate the Lambda value

Calculate the appropriate number of additional samples using alpha=0.05 and ß= 0.05

PROBLEM 1 ANSWER SHEET

Given three samples with chromium concentrations of 4.93, 4.21, and 4.84 mg/l and

$$X = 4.66 \ mg/l$$

(1a) Calculate S^2

$$S^2 = [\,(X_1\text{-}X)^2 + (X_2\text{-}X)^2 + \ldots (X_n\text{-}X)^2\,] \,/\, n\text{-}1$$

$$= [\,(4.93 - 4.66)^2 + (4.21 - 4.66)^2 + (4.84 - 4.66)^2] \,/2$$

$$= 0.15$$

Calculate S

$$S = (S^2)^{1/2} = (0.15)^{1/2} = 0.39$$

Calculate Sx

$$Sx = S/(n)^{1/2} = 0.39/(3)^{1/2} = 0.23$$

(1b) Calculate the 95% UCL

$$95\%\ UCL = X + [t_{0.95,(n-1)}]*Sx$$

$$= 4.66 + (2.920)*(0.23)$$

$$= 5.33$$

(1c)

$$90\%\ UCL = X + [t_{0.90,(n-1)}]*Sx$$

$$= 4.66 + (1.886)*(0.23)$$

$$= 5.09$$

$$80\%\ UCL = X + [t_{0.80,(n-1)}]*Sx$$

$$= 4.66 + (1.061)*(0.23)$$

$$= 4.90$$

The preceding two calculations indicate that it can be stated with somewhere between 80% and 90% confidence that the chromium concentration does not exceed the RT. This degree of confidence may not be sufficient to meet the needs of the sampling plan. Therefore, more samples may need to be taken.

2a. Calculate the Lambda value

$$Lambda = (RT - X) / S$$

$$= (5.0 - 4.66) / 0.39 = 0.87$$

2b. Calculate the number of additional samples

Using Attachment 2, Number of Observations for t Test of Mean, page 36 of this Guidance Document, using a single-sided test with alpha=0.05 and ß=0.05, approximately 15 to 17 total samples need to be collected. Therefore, based on the three preliminary samples that were collected, an additional 13 samples need to be taken.

Cumulative t Distribution

one-tailed	0.550	0.750	0.080	0.900	0.950	0.975	0.990
two-tailed	0.100	0.500	0.600	0.800	0.900	0.950	0.980
1	0.158	1.000	1.376	3.078	6.314	12.706	31.82
2	0.142	0.816	1.061	1.886	2.920	4.303	6.925
3	0.137	0.765	0.978	1.638	2.353	3.182	4.541
4	0.134	0.741	0.941	1.533	2.132	2.776	3.747
5	0.132	0.727	0.920	1.476	2.015	2.571	3.365
6	0.131	0.718	0.906	1.440	1.943	2.447	3.143
7	0.130	0.711	0.896	1.415	1.895	2.365	2.998
8	0.130	0.706	0.889	1.397	1.860	2.306	2.896
9	0.129	0.703	0.883	1.383	1.833	2.262	2.821
10	0.129	0.700	0.879	1.372	1.812	2.228	2.764
11	0.129	0.697	0.876	1.363	1.796	2.201	2.718
12	0.128	0.695	0.873	1.356	1.782	2.179	2.681
13	0.128	0.694	0.870	1.350	1.771	2.160	2.650
14	0.128	0.692	0.868	1.345	1.761	2.145	2.624
15	0.128	0.691	0.866	1.341	1.753	2.131	2.602
16	0.128	0.690	0.865	1.337	1.746	2.120	2.583
17	0.128	0.689	0.863	1.333	1.740	2.110	2.567
18	0.127	0.688	0.862	1.330	1.734	2.101	2.552
19	0.127	0.688	0.861	1.328	1.729	2.093	2.539
20	0.127	0.687	0.860	1.325	1.725	2.086	2.528
21	0.127	0.686	0.859	1.323	1.721	2.080	2.518
22	0.127	0.686	0.858	1.321	1.717	2.074	2.508
23	0.127	0.685	0.858	1.319	1.714	2.069	2.500
24	0.127	0.685	0.857	1.318	1.711	2.064	2.492
25	0.127	0.684	0.856	1.316	1.708	2.060	2.485
26	0.127	0.684	0.856	1.315	1.706	2.056	2.479
27	0.127	0.684	0.855	1.314	1.703	2.052	2.473
28	0.127	0.683	0.855	1.313	1.701	2.048	2.467
29	0.127	0.683	0.854	1.311	1.699	2.045	2.462
30	0.127	0.683	0.854	1.310	1.697	2.042	2.457
40	0.126	0.681	0.851	1.303	1.684	2.021	2.423
60	0.126	0.679	0.848	1.296	1.671	2.000	2.390
120	0.126	0.677	0.845	1.289	1.658	1.980	2.358
	0.126	0.674	0.842	1.282	1.645	1.960	2.326

NOTE: For one-tailed distributions a/2 = 1-p
For two-tailed distributions a = 1-p

NUMBER OF OBSERVATIONS FOR t TEST OF MEAN
Level for t Test

Single-sided	A=0.005				A=0.01					A=0.025			
Double-sided	A=0.01				A=0.02					A=0.05			
B=0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2	0.5	0.01	0.05	0.1	0.2

LAMBDA														
0.15														
0.20										139				
0.25					110					90				128
0.30				134	78				115	63			119	90
0.35			125	99	58			109	85	47		109	88	67
0.40		115	97	77	45		101	85	66	37	117	84	68	51
0.45		92	77	62	37	110	81	68	53	30	93	67	54	41
0.50	100	75	63	51	30	90	66	55	43	25	76	54	44	34
0.55	83	63	53	42	26	75	55	46	36	21	63	45	37	28
0.60	71	53	45	36	22	63	47	39	31	18	53	38	32	24
0.65	61	46	39	31	20	55	41	34	27	16	46	33	27	21
0.70	53	40	34	28	17	47	35	30	24	14	40	29	24	19
0.75	47	36	30	25	16	42	31	27	21	13	35	26	21	16
0.80	41	32	27	22	14	37	28	24	19	12	31	22	19	15
0.85	37	29	24	20	13	33	25	21	17	11	28	21	17	13
0.90	34	26	22	18	12	29	23	19	16	10	25	19	16	12
0.95	31	24	20	17	11	27	21	18	14	9	23	17	14	11
1.00	28	22	19	16	10	25	19	16	13	9	21	16	13	10
1.1	24	19	16	14	9	21	16	14	12	8	18	13	11	9
1.2	21	16	14	12	8	18	14	12	10	7	15	12	10	8
1.3	18	15	13	11	8	16	13	11	9	6	14	10	9	7
1.4	16	13	12	10	8	14	11	10	9	6	12	9	8	7
1.5	15	12	11	9	7	13	10	9	8	6	11	8	7	6
1.6	13	11	10	8	6	12	10	9	7	5	10	8	7	6
1.7	12	10	9	8	6	11	9	8	7		9	7	6	5
1.8	12	10	9	8	6	10	8	7	7		8	7	6	
1.9	11	9	8	7	6	10	8	7	6		8	6	6	
2.0	10	8	8	7	5	9	7	7	6		7	6	5	
2.1	10	8	7	7		8	7	6	6		7	6		
2.2	9	8	7	6		8	7	6	5		7	6		
2.3	9	7	7	6		8	6	6			6	5		
2.4	8	7	7	6		7	6	6			6			
2.5	8	7	6	6		7	6	6			6			
3.0	7	6	6	5		6	5	5			5			
3.5	6	5	5			5								
4.0	6													

99% confidence

SAMPLING PROCESS STREAMS

Although sampling is generally thought to occur on a pile of material or over an area of treated soil, other schemes are possible. The most common instance is when the material is to be sampled at the point of generation. This is the preferred method, since it is most representative of the material under study. The lack of exposure to elements that might cause chemical degradation and/or leaching will result in material most indicative of actual conditions.

A sampling point along the material conveyor that can be fairly easily and safely reached should be chosen. It should be in an area where the entire belt can be accessed for sampling.

Under this scenario, a temporal, rather than a spatial, approach needs to be used.

Time stratum should be established over the course of the process day. Ideally, the entire active time of the line should be included in the sampling scheme. Once time strata are chosen, the random numbers table can be used to establish sampling times. For a four hour period, a point somewhere on the table would be chosen and every number greater than 0 but less than 240 would be selected until the number of samples for that strata were obtained. The number would relate to time in minutes. This would be added to the starting time for that strata to determine the time of sampling.

If the time strata chosen are of unequal lengths, the number of samples chosen from any one strata should reflect the percentage contribution that strata makes to the time frame as a whole. For example, if for a 24 hour operating time, strata 1 is 4 hours and strata 2 is 8 hours, strata 2 should have twice as many samples as strata 1.

When the appropriate sampling time arrives, the material from the conveyor belt point that had been identified would be removed. This material should be well mixed and a subsample taken for inclusion in the jar for lab analysis. An example of the use of this protocol is attached.

RANDOM TIME WASTE SAMPLING EXAMPLE

	Sampling Point	Random Minute	Time
Stratum #1 6:00 to 8:00 hours	1	28	6:28
	2	62	7:02
	3	99	7:39
	4	112	7:52
Stratum #2 8:00 to 20:00 hours	1	11	8:11
	2	107	9:47
	3	156	10:36
	4	173	10:53
	5	296	12:56
	6	313	13:13
	7	398	14:38
	8	497	16:17
	9	555	17:15
	10	600	18:00
	11	637	18:37
	12	706	19:46
Stratum #3 20:00 to 22:00 hours	1	13	20:13
	2	52	20:52
	3	88	21:28
	4	108	21:48
Stratum #4			

8:00 to 20:00 hours	1	48	22:48
	2	113	23:53
	3	153	24:33
	4	189	1:09
	5	227	1:47
	6	290	2:49
	7	314	3:14
	8	474	5:44

ATTACHMENT 3

TOLERANCE FACTORS (*K*)

TOLERANCE FACTORS (*K*) FOR ONE-SIDED NORMAL TOLERANCE INTERVALS WITH PROBABILITY Y = 0.95 AND COVERAGE P = 95%

n	*K*	n	*K*
3	7.655	75	1.972
4	5.145	100	1.924
5	4.202	125	1.891
6	3.707	150	1.868
7	3.399	175	1.850
8	3.188	200	1.836
9	3.031	225	1.824
10	2.911	250	1.814
11	2.815	275	1.806
12	2.736	300	1.799
13	2.670	325	1.792
14	2.614	350	1.787
15	2.566	375	1.782
16	2.523	400	1.777
17	2.486	425	1.773
18	2.453	450	1.769
19	2.423	475	1.766
20	2.396	500	1.763
21	2.371	525	1.760
22	2.350	550	1.757
23	2.329	575	1.754
24	2.309	600	1.752
25	2.292	625	1.750
30	2.220	650	1.748
35	2.166	675	1.746
40	2.126	700	1.744
45	2.092	725	1.742
50	2.065	750	1.740
55	2.036	775	1.739
60	2.017	800	1.737
65	2.000	825	0.736
70	1.986	850	1.734
		875	1.733
		900	1.732
		925	1.731
		950	1.729
		975	1.728

1,000	1.727

SOURCE: FOR SAMPLE SIZES < 50: Lieberman, Gerald F. 1958. "Tables for One-sided Statistical Tolerance Limits." Industrial Quality Control. Vol. XIV, No. 10.

FOR SAMPLE SIZES > 50: K values were calculated from large sample approximation.

NTIS Document PB-89-151-047

ATTACHMENT 4

WASTE MANAGEMENT DIVISION'S

CLEAN CLOSURE CERTIFICATION CHECKLIST

This checklist was developed to review RCRA clean closures. Due to direct reference to 40 CFR, Part 264, Subpart G, by Act 64, Rule 613; Act 64 closures should also be evaluated by this checklist.

Documentation supporting the owners/operators and the independent registered professional engineer's certification can be requested under 40 CFR, 264.115 and 265.115 (as of October 29, 1986). The owner/operator must submit at least four copies of certification documentation.

The checklist identifies items recommended to properly evaluate a closure certification. These items are not "absolutes." Other information or substitutions may be provided which technically justify and certify a "clean closure."

This checklist can be used for land disposal, storage, and treatment facilities. Several of the items would not be required for storage and/or treatment facilities where testing was minimal. Items 1 through 5 would be required for all closures. Items 6 through 11 would be optional for storage and/or treatment facilities, dependent on extent of testing required. Land disposal facilities would require all items listed.

1. Manifests (or some type of manifest/waste removal summary) of where and how much waste was shipped.

2. Certification statement is needed by the owner/operator AND an independent registered engineer. All independent registered professional engineer certificates must have an original stamp on at least one copy.

3. Summary of decontamination procedures (pressure wash, Steam clean, etc.) and how the resultant waste water was disposed.

4. Summary analysis (include conditions of haul roads, time table, soil and groundwater

results, weather conditions, runoff controls, equipment decontamination, etc.).

5. Results of all tests used to determine clean closure (charts, tables, lab sheets).

6. Statistical comparisons on sampling results compared to cleanup criteria (this should include full computations on background and statistical analysis).

7. Sampling and analysis procedures (specify references).

8. Final depth and elevations of excavations of wastes and soils.

---

9. Properly labeled and easily identified sampling locations and grid stations (map) including background stations.

10. Groundwater data (and statistical evaluation) used to determine if groundwater degradation has occurred (usually four sets of replicate analysis compared to sampling event after closure activities). Monitor well construction details and sampling and analysis procedures may be required if documentation is not in the file.

11. Summary of final restoration of excavated area...
information on fill material used and/or future land use outline. If clean closure cannot be achieved (e.g., contaminated soils to water table and groundwater results show contamination). This summary item should be used to address the need for any post closure program and/or corrective action.

12. A copy of all field notes pertaining to these closure activities.

13. A copy of the approved closure plan and letter of closure plan approval.

CITED REFERENCES

Borden, R.C., Bedient, P.B., In-Situ Measurement of Adsorption and Biotransformation at a Hazardous Waste Site, Water Resources Bulletin, 23 (4), pp. 629-636, 1987

Cline, P.V., Brown S., Site Specific Evaluation of Contaminant Fate: Test Applications and Limitations, Superfund '89, Hazardous Materials Control Research Institute, Silver Springs, MD, 1989

Davis, J.C., Statistics and Data Analysis in Geology, 2nd ed., John Wiley and Sons, New York, 1986

Gilbert, R.O., Statistical Methods for Environmental Pollution Monitoring. Van Nostrand, New York, 1987

Lindsay, W.L., Chemical Equilibria In Soils, John Wiley and Sons, New York, 1979

Schwille, F., Dense Non-Aqueous Phase Liquids In Porous and Fractured Media-Model Experiments, Lewis Publishers, Boca Raton, LA, 1988

US EPA, Office of Policy, Planning, and Evaluation, Methods for Evaluating the Attainment of Cleanup Standards, Volume 1: Soils and Solid Media, EPA 230/02-89-042, Washington D.C., 1989

US EPA, Office of Solid Waste Management Division, Test Methods for Evaluating Solid Waste, SW-846 Volume II: Field Methods, US EPA, November 1986, Third Edition

US EPA, Office of Solid Waste Management Division, Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim final Guidance, EPA, Washington D.C., April 1989.

US EPA, Office of Solid Waste Management Division, Statistical Analysis of Groundwater Monitoring data at RCRA Facilities, Addendum to Interim Final Guidance, EPA, Washington D.C., June 1992.

Wilson, J.T., Wilson B.H., Biotransformation of Trichloroethylene in Soil, Applied Environmental Microbiology, 49:242-243, 1985

WMD, DNR, Draft Guidance, How Clean is Clean, May 1988

ASTM STP-540, Sampling Standards and Homogeneity, Kennedy/Woodruff, Baltimore MD, 1973

ASTM STP-845, Statistics in the Environmental Sciences, Gentz/London editors, Baltimore MD, 1986

Underwood, E.E., Quantitative Stereology. Addison-Wesley, Reading Massachusetts, 1970

A.2 VERIFICATION SAMPLING GRID INTERVAL RATIONALE

CLIENT: NCBC Gulfport		JOB NUMBER: N7379
SUBJECT: Verification Sampling Grid Interval Calculation		
BASED ON: Michigan Guidance - Verification of Soil Remediation		DRAWING NUMBER:
DESIGN BY: JJB DATE: 5/20/03	CHECKED BY: RRJ DATE 5/20/03:	APPROVED BY: DATE:

PURPOSE:

To determine the sampling grid interval for sediment verification sampling for areas impacted by past storage of Herbicide Orange at Site 8, Herbicide Orange (HO) Storage Area, at the NCBC Gulfport, Mississippi.

APPROACH:

In efforts to remove dioxin-contaminated sediment from areas impacted by past HO storage at Site 8, the Navy will excavate two discrete areas during the Site 8 remedial action:

- The off-base area of contamination (AOC) (Ardnt and Bennett properties) located in wetland north of the NCBC's Outfall 3 (see Figure 1 on page 3).
- On-base drainage channels within and contiguous to Site 8 (see Figure 2 on page 4).

Michigan guidance titled "Verification of Soil Remediation" will be used to determine the grid interval for the verification sampling in these areas. According to the Michigan guidance, the grid interval for large sites (greater than 3 acres) is determined by the following equation:

$$GI = [(A*\Pi)/SF]^{\wedge 0.5}$$

Where:

GI = Grid Interval (ft)
SF = Site Factor, length of area to be grid (unitless)
A = Area to be grid (square feet) = plan view excavation area + sidewall area

ASSUMPTIONS:

- See Pages 5 and 6.

CALCULATIONS:

- See Pages 5 and 6.

CLIENT: NCBC Gulfport		JOB NUMBER: N7379
SUBJECT: Verification Sampling Grid Interval Calculation		
BASED ON: Michigan Guidance - Verification of Soil Remediation		DRAWING NUMBER:
DESIGN BY: JJB DATE: 5/20/03	CHECKED BY: RRJoh DATE 5/20/03:	APPROVED BY: DATE:

CONCLUSIONS:

Using the Michigan guidance, the grid intervals were calculated as shown.

Area	Grid Interval
Off-base AOC	22.9
On-base drainage channels	8.3

However, the Michigan guidance states that grid interval range for large sites (3.0 acres or larger) should be 30 feet or greater. The fact that the grid interval is below this 30-foot value is a function of the narrow configuration of the drainage channels. In lieu of the calculated values, the grid interval for both areas will be set as 30 feet.

REFERENCES:

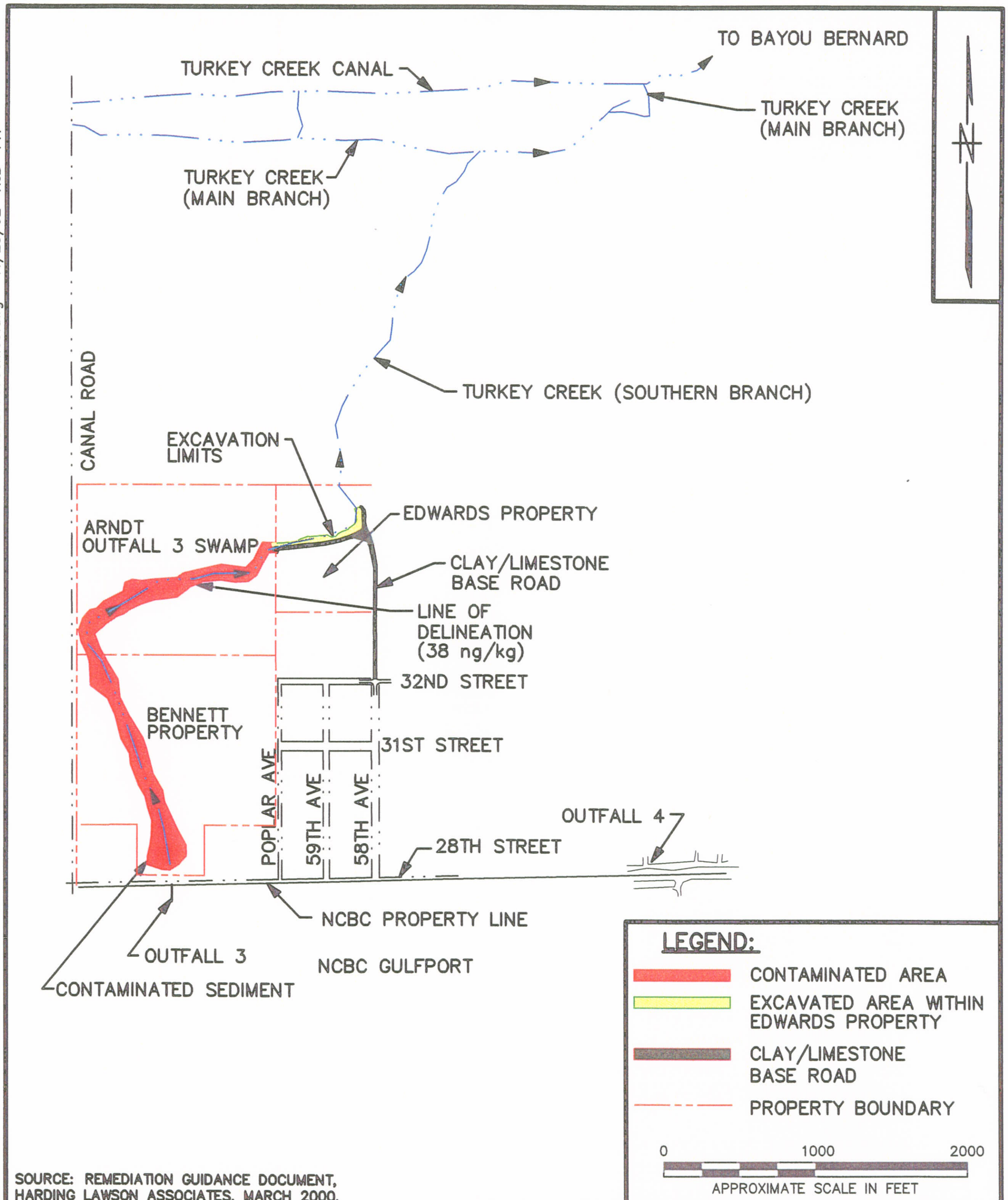
1. Tetra Tech Nus, Inc. 2003. Draft Site Characterization Report, NCBC Off-base Area of Contamination, Naval Construction Battalion Center, Gulfport, Mississippi. prepared by Tetra Tech NUS, Inc. for the Naval Facilities Engineering Command, Southern Division, April

2. Michigan Department of Environmental Quality, 1994. Guidance Document: Verification of Soil Remediation, Environmental Response Division, Waste Management Division, April.

3 Calculation titled "Volume of Contaminated On-Base Sediment Calculation" located in Appendix A of the report titled "Focused Feasibility Study, Site 8 Herbicide Orange Storage Area, Naval Construction Battalion Center, Gulfport, Mississippi, March 2003" prepared by Tetra Tech NUS, Inc. for the Naval Facilities Engineering Command, Southern Division.

4. Calculation titled "Material Volume Calculation" located in Appendix B of the report titled "60% Remedial Design, Site 8 – Herbicide Orange Storage Area and Off-base Area of Contamination, NCBC Gulfport, Mississippi, May 2003" prepared by Tetra Tech NUS, Inc. for the Naval Facilities Engineering Command, Southern Division.

ACAD: 7379cm09.dwg 11/25/02 HJB PIT

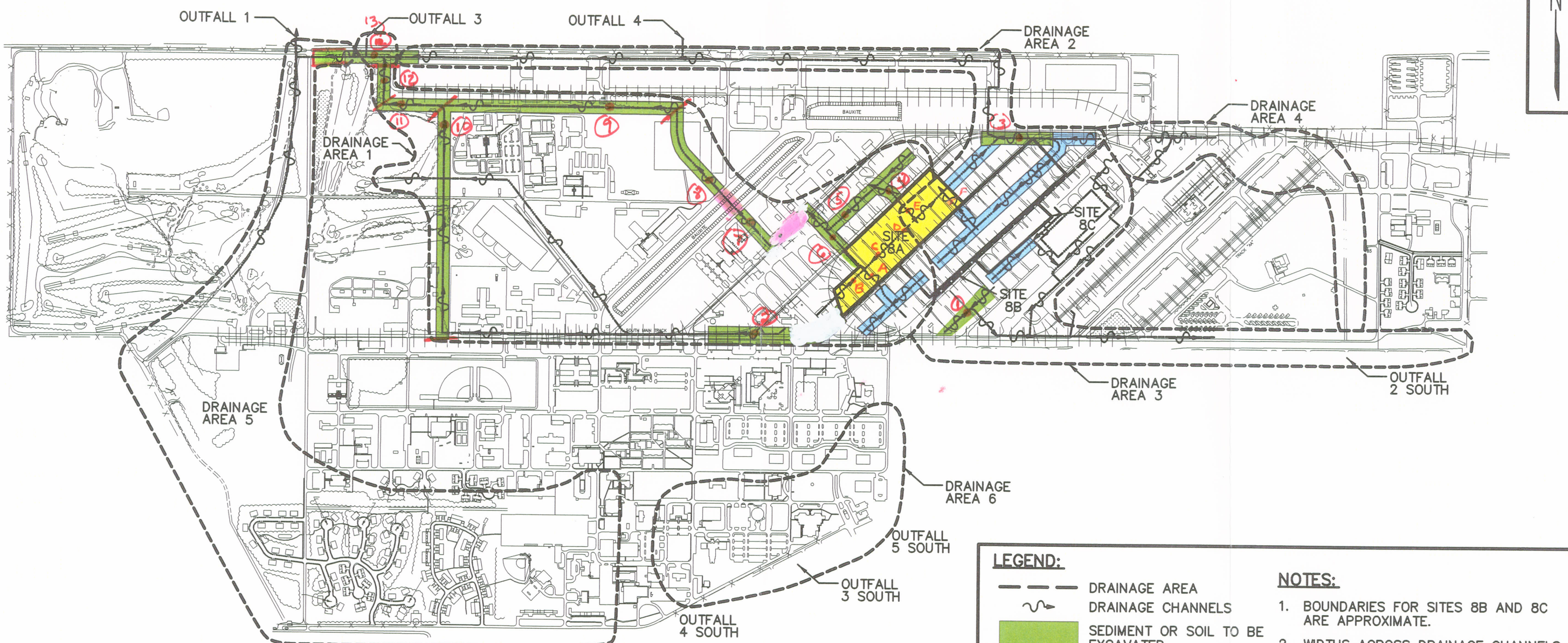


DRAWN BY MF / DATE 11/14/02	DEPARTMENT OF THE NAVY · SOUTHERN DIV FACILITIES ENGINEERING COMD	AREAL EXTENT OF OFF-BASE CONTAMINATED MEDIA	CONTRACT NO. 7379
CHECKED BY / DATE		~~SITE 8 BASIS OF DESIGN~~	APPROVED BY / DATE
COST/SCHED-AREA		NAVAL CONSTRUCTION BATTALION CENTER	APPROVED BY / DATE
SCALE AS NOTED		GULFPORT, MISSISSIPPI	DRAWING NO. FIGURE 1 / REV. 0

FORM CADD NO. SDIV_AV.DWG - REV 0 - 1/20/98

Site 8 Verification Sampling & Analysis Plan

ACAD: 7379GP22.dwg 04/25/03 DM PIT



LEGEND:

- DRAINAGE AREA
- DRAINAGE CHANNELS
- SEDIMENT OR SOIL TO BE EXCAVATED.
- AREA TO BE USED FOR STAGING AND STORAGE AREA (SITE 8A)
- SEDIMENT OR SOIL EXCAVATED (CH2MHILL, 2002)

NOTES:

1. BOUNDARIES FOR SITES 8B AND 8C ARE APPROXIMATE.
2. WIDTHS ACROSS DRAINAGE CHANNELS ARE NOT TO SCALE.

Segments of channel below ground surface

0 1000 2000
SCALE IN FEET

SOURCE: NAVAL CONSTRUCTION BATTALION CENTER, GULFPORT MS., JUNE 2001

NO.	DATE	REVISIONS	BY	CHKD	APPD	REFERENCES

DRAWN BY DM DATE 4/24/03
CHECKED BY DATE
COST/SCHED-AREA
SCALE AS NOTED

DEPARTMENT OF THE NAVY * SOUTHERN DIV FACILITIES ENGINEERING COMMAND

AREAL EXTENT OF ON-BASE CONTAMINATED MEDIA

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

CONTRACT NO. 7379
APPROVED BY DATE
APPROVED BY DATE
DRAWING NO. FIGURE 2
REV. 0

FORM CADD NO. SDIV_BH.DWG - REV 0 - 1/20/98

Calculations and Assumptions

Off-base AOC Assumptions		Source
(a)	1.5 = depth of excavation (ft)	Ref. 1
(b)	3,045 = length of excavation (ft) or site factor (SF)	Ref. 4
(c)	499,051 = plan view excavation area (Ardnt and Bennett property) (sf)	Ref. 4
(d)	11.5 = plan view excavation area (Ardnt and Bennett property) (acres)	(c)/43560
(e)	164 = average width (ft)	(c)/(b)
(f)	6,418 = excavation perimeter (ft)	(b)*(2) + (e)*(2)
(g)	9,627 = area of sidewalls (sf)	(f)*(a)

Calculation: Off-base AOC

Per Reference 2, the off-base AOC is classified as a large site (> 3 acres), therefore the following equation is used:

$GI = [(A*\Pi)/SF]^{0.5}$ eq. 1

Where:
GI = Grid Interval
SF = Site Factor, length of area to be grid (unitless)
A = Area to be grid (square feet) = plan view excavation area + sidewall area

		Source
A =	508,678 sf	(c) + (g)
GI =	22.9 ft	eq. 1

On-base Drainage Channel Assumptions		Source
(a)	1.0 = depth of excavation at top of slope (ft)	Assumed
(b)	18.8 = average width of excavation (ft)	Table 1
(c)	14,125 = length of excavation (ft) or site factor (SF)	Table 1
(d)	281,355 = plan view excavation area (sf)	Table 1
(e)	6.5 = plan view excavation area (acres)	(d)/43560
(f)	28,288 = excavation perimeter (ft)	(c)*(2) + (b)*(2)
(g)	28,288 = area of sidewalls (sf)	(f)*(a)

Calculation: On-base Drainage Channels

Per Reference 2, the Off-base AOC is classified as a large site (> 3 acres), therefore the following equation is used:

$GI = [(A*\Pi)/SF]^{0.5}$

Where:
GI = Grid Interval
SF = Site Factor, length of area to be grid (unitless)
A = Area to be grid (square feet) = plan view excavation area + sidewall area

		Source
A =	309,643	(d) + (g)
GI =	8.3	eq. 1

Table 1
Areal Extent of Disturbance: On-base Drainage Channels
NCBC Gulfport, Mississippi

On-base Drainage Channels[1]			
Stream Segment (see Figure 2)	Width[2] (ft)	Segment Length (ft)[3]	Areal Excavation Extent[4] (sf)
1	11	540	5,940
2	11	745	8,195
3	23	550	12,650
4	16	240	3,840
5	13	1065	13,845
6	16	690	11,040
7	22	405	8,910
8	22	890	19,580
9	30	2100	63,000
10	24	2070	49,680
11	22	555	12,210
12	24	420	10,080
13	21	990	20,790
[5]	22	730	16,060
		11,990	**255,820**

Site 8A Drainage Channels			
Stream Segment (see Figure 2)	Width[2] (ft)	Segment Length (ft)[3]	Areal Excavation Extent[4] (sf)
A	11	225	2,475
B	14	350	4,900
C	10	200	2,000
D	9	920	8,280
E	22	240	5,280
F	13	200	2,600
		2,135	**25,535**

Totals		**14,125**	**281,355**

Weighted Averages

Channel Width 18.8 feet

1. Consists of drainage channels outside the boundary of Site 8A that have not been excavated as of May 2003.
2. Based on field measurments taken in August 2000 (Reference 3).
3. Based on measurements taken from Drawings C-1 and C-2 of Reference 4.
4. As a rough estimate, areal excavation extent is approximated as (width)*(segment length)
5. Segments of drainage channel below ground surface as shown on Figure 2. Width of channel assumed.

NA = Not Applicable/Not Available

A.3 EXAMPLE SOIL AND SEDIMENT SAMPLE LOG SHEET

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ______________________

Project No.: ______________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ______________________
[] QA Sample Type: ______________________

Sample ID No.: ______________________

Sample Location: ______________________

Sampled By: ______________________

C.O.C. No.: ______________________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:				
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

APPENDIX B

HEALTH AND SAFETY PLAN (HASP)

HEALTH AND SAFETY PLAN

The attached Health and Safety Plan (HASP) was developed for field activities conducted in the off-base area of contamination (AOC) from October 2002 to April 2003 and covers field tasks that will be performed as part of VSAP activities. The following HASP-related issues can be found in the following sections:

- Emergency Action Plan – Section 2.0 of the HASP
- Site Background – Section 2.0 of the VSAP
- Scope of Work – The scope of VSAP field tasks includes:
  - Mobilization and demobilization
  - The collection of sediment samples within the on-base drainage channels and off-base AOC and soil samples from the subgrade of the materials handling pad.
  - The collection of groundwater samples from permanent monitoring wells surrounding Site 8 and temporary wells within the off-base AOC
  - Decontamination of sampling equipment
  - IDW management
- Tasks/Hazards/Associated Control Measures Summary – Section 5.0 of the HASP
- Hazard Assessment – Section 6.0 of the HASP
- Hazard Monitoring – Section 7.0 of the HASP
- Training and Medical Surveillance Requirements – Section 8.0 of the HASP
- Spill Prevention and Containment Program – Section 9.0 of the HASP
- Site Operations and Controls – Section 10.0 of the HASP
- Confined Space Entry – Section 11.0 of the HASP
- Material and Documentation – Section 12.0 of the HASP

ATTACHMENT 1

HEALTH AND SAFETY PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT GULFPORT, MISSISSIPPI

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0278

March 2003

HEALTH AND SAFETY PLAN

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT
GULFPORT, MISSISSIPPI

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION-NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, South Carolina 29406

Submitted by:
TETRA TECH NUS
661 Andersen Drive Foster Plaza 7
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0278

MARCH 2003

PREPARED UNDER THE SUPERVISION OF:

JASON J. BROWN
TASK ORDER MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

APPROVED FOR SUBMITTAL BY:

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CLEAN HEALTH AND SAFETY MANAGER
TETRA TECH NUS, INC.
PITTSBURGH, PENNSYLVANIA

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1.0 INTRODUCTION

Authorization: This Health and Safety Plan (HASP) and the work described within are completed under the authorization of:

Contract: Comprehensive Long-Term Environmental Action Navy (CLEAN III)

Contract Number: N62467-94-D-0888

Contract Task Orders: 0278

Statement of Work: CTO 278, SOW #296 – Edwards Road Restoration, Community Groundwater Sampling, Site 7 Sampling

- Provide road repair and road shoring activities for the prevention of erosion on the Edwards property.
- Perform sampling and analysis of two monitoring wells at Site 7
- Perform sampling and analysis of three off-site drinking wells
- Excavate sediment that has been contaminated with dioxins resulting from the past storage of Herbicide Orange at the NCBC Gulfport, Mississippi. Approximately 20 cubic yards of sediment adjacent to Canal Road will be excavated prior to the start of a City of Gulfport culvert replacement project.
- Transport the excavated sediment to Site 8A at the NCBC Gulfport.
- Construct a sediment recovery trap (SRT) at the eastern most extent of the excavation.

Proposed Dates of Work: March 2003 to March 2004

Application: This Health and Safety Plan (HASP) has been written to encompass site activities that are to be conducted at the Naval Construction Battalion Center (NCBC) located in Gulfport, Mississippi. Activities to be conducted as per this HASP are defined in detail in Section 4.0.

Compliance: The elements of this HASP are intended to be in compliance with the requirements established by:

- OSHA 29 CFR 1910.120, "Hazardous Waste Operations and Emergency Response" (HAZWOPER)
- Applicable sections of 29 CFR 1926 "Safety and Health Regulations For Construction."
- Tetra Tech NUS Health and Safety Program

This HASP must be accompanied by the Tetra Tech NUS, Inc. Health and Safety Guidance Manual (TtNUS HSGM). The Guidance Manual provides additional information on program support, standard operating procedures, and safe work practices.

Modifications/Changes: The following conditions are considered sufficient basis review and possible changes to this document

- The addition or modification of activities outside of those specified in Section 4.0, Scope of Work.
- New information becomes available through the course of the investigation or from outside sources.

All changes to this HASP will be requested through the Task Order Manager (TOM) to the Tetra Tech NUS Health and Safety Manager (HSM). It is the responsibility of the TOM to notify all affected personnel of all changes to this HASP. Changes to the HASP will be documented using a Document Review Record.

1.1 KEY PROJECT PERSONNEL AND ORGANIZATION

This section defines responsibility for site safety and health for TtNUS and subcontractor employees engaged in on-site activities. Personnel assigned to these positions will exercise the primary responsibility for all on-site health and safety. These persons will be the primary points of contact for any questions regarding the safety and health procedures and the selected control measures that are to be implemented for on-site activities.

- The TtNUS TOM is responsible for the overall direction of health and safety for this project. This includes but is not limited to, providing
  - I. Prepares background review - Results from past investigation activities at Gulfport (pertinent data - peak concentrations/exceedances by site media for each contaminant at each location of the investigation).
  - II. Specific scope of work that TtNUS will be performing.
  - III. Points of Contact within NCBC Gulfport (i.e., Base Contact, Base Security, Utilities, Emergency notification procedures, closest hospital, Facility Emergency Response capabilities, etc.)
  - IV. Obtains site access, not only to the base, but also to files and records that may have some bearing or pertinence pertaining to this project.

- The Project Health and Safety Officer (PHSO) is responsible for developing this HASP in accordance with applicable OSHA regulations. Specific responsibilities include:

  - i. Providing information regarding site contaminants and physical hazards associated with the site and tasks to be conducted.
  - ii. Establishing air monitoring and decontamination procedures.
  - iii. Assigning personal protective equipment based on task and potential hazards.
  - iv. Determining emergency action/response procedures and emergency contacts.
  - v. Stipulating training and medical surveillance requirements.

vi. Providing standard work practices to minimize potential injuries and exposures associated with hazardous waste work.
vii. Modifying this HASP, as it becomes necessary.

- The TtNUS Field Operations Leader (FOL) is responsible for implementation of the HASP with the assistance of an appointed Site Safety Officer (SSO). The FOL manages field activities, executes the work plan, and enforces safety procedures as applicable to the work plan.

- The SSO supports site activities by advising the FOL on all aspects of health and safety on-site. In this capacity the SSO:

  i. Coordinates all health and safety activities with the FOL.
  ii. Selects, applies, inspects, and maintains personal protective equipment.
  iii. Establishes work zones and control points in areas of operation.
  iv. Implements air monitoring program for on-site activities.
  v. Verifies training and medical clearance of on-site personnel status in relation to site activities.
  vi. Implements Hazard Communication, Respiratory Protection Programs, and other associated health and safety programs as they may apply to site activities.
  vii. Coordinates TtNUS emergency actions with the facilities emergency services.
  viii. Provides site-specific training for all on-site personnel.
  ix. Investigates all accidents and injuries (see Attachment I - Illness/Injury Procedure and Report Form)
  x. Provides input to the PHSO regarding the need to modify, this HASP, or applicable health and safety associated documents as per site-specific requirements.

- Compliance with the requirements stipulated in this HASP is monitored by the SSO and coordinated through the TtNUS CLEAN HSM.

Note: In some cases one person may be designated responsibilities for more than one position. For example, at NCBC Gulfport the FOL may also be responsible for the SSO duties. This action will be performed only as credentials, experience, and availability permits.

1.2 SITE INFORMATION AND PERSONNEL ASSIGNMENTS

Site Name: Naval Construction Battalion Center

Address: Gulfport, Mississippi

Navy Engineer-in-Charge (EIC): Mr. Arthur Conrad

Phone Number: (843) 820-5520

Facility Contact: Mr. Gordon Crane

Phone Number: (228) 871-2485
Pager Number: 1(800) 343-3472

Purpose of Site Visit: This activity is divided into a multi-task operation (see Section 3.0).

Project Team:

TtNUS Personnel:	Discipline/Tasks Assigned:	Phone Number:
Jason Brown	Task Order Manager (TOM)	412/921-8401
Matthew M. Soltis, CIH, CSP	CLEAN Health and Safety Manager (HSM)	412/921-8912
Thomas M. Dickson, CSP	Project Health and Safety Officer (PHSO)	412/921-8457
TBD	Field Operations Leader (FOL)	
TBD	Site Safety Officer (SSO)	
Tom Patton	Equipment Manager	412/262-4583

Non-TtNUS Personnel	Affiliation/Discipline/Tasks Assigned	
TBD	Analytical (Chemical) Laboratory	
TBD	Excavation Contractor	
FedEx	Parcel/Sample Shipment	1(800)463-3339

Hazard Assessments (for purposes of 29 CFR 1910.132) and HASP preparation conducted by:

Thomas M. Dickson, CSP
TBD - To Be Determined

Shipping Address at NCBC Gulfport:
NCBC Gulfport
Building 320, Shipping and Receiving Warehouse
Attention: Mr. Gordon Crane/Tetra Tech NUS, Inc.
5200 CBC 2nd Street
Gulfport, Mississippi 39501-5000

2.0 EMERGENCY ACTION PLAN

2.1 INTRODUCTION

This section has been developed as part of a planning effort to direct and guide field personnel in the event of an incidental or emergency release or occurrence. Tetra Tech NUS will, through necessary services, include incidental response measures for incidents such as:

- Initial stage fire fighting support and prevention
- Initial spill control and containment measures and prevention
- Removal of personnel from emergency situations
- Provide initial medical support for injuries or illnesses requiring only first-aid level support
- Provide site control and security measures as necessary

Incidental response measures will only be provided to the capabilities of on-site personnel and available resources. Incidental response measures are not considered an emergency response as per 29 CFR 1910.120 (b). Incidents and situations that are deemed to be an emergency response as defined by 29 CFR 1910.120 (b) will be handled by outside resources. It has been determined that these off-site response agencies are capable of providing the most effective response and will be designated as the primary responders. These agencies are located within a reasonable distance from the area of site operations, which ensures adequate emergency response time. These agencies will be contacted through NCBC Gulfport Emergency Dispatch. This Emergency Action Plan conforms to the requirements of 29 CFR 1910.38(a), as allowed in 29 CFR 1910.120(l)(1)(ii).

2.2 EMERGENCY PLANNING

Based on planned activities, the potential for field personnel to encounter significant emergency situations is minimal. However, based on the initial hazard/risk assessment effort, some potential exists for injuries or illnesses resulting from exposure to chemical and/or physical hazards or fire could be encountered during site activities. To minimize and eliminate these potential emergency situations, emergency planning activities associated with this project, the following responsibilities are assigned to the FOL and/or the SSO:

- Coordinating response actions with NCBC Gulfport Emergency Services personnel to ensure that TtNUS emergency action activities are compatible with existing facility emergency response procedures. This will serve as the initial review of the Emergency Action Plan.

- Establishing and maintaining information at the project staging area (Support Zone) for easy access in the event of an emergency. This information includes the following:

  - Chemical Inventory (for substances used on-site), with Material Safety Data Sheets.
  - On-site personnel medical records (medical data sheets).
  - A logbook identifying personnel on-site each day.
  - Emergency notification phone numbers in all site vehicles

Note: It is the responsibility of the TtNUS FOL and/or the SSO to ensure that this information is available and present at the site.

- Identifying a chain of command for emergency action.
- Educating site workers to the hazards and control measures associated with planned activities at the site, and providing early recognition and prevention, where possible.
- Preview work areas to remove physical hazards where identified.

2.3 EMERGENCY RECOGNITION AND PREVENTION

The primary focus of this section is the ability to recognize and control factors, which could contribute to an emergency situation/condition. The FOL, and/or the SSO will preview all site work location prior to committing personnel or resources. Their actions will be as follows:

- Identify, remove, and/or barricade physical hazards within the estimated work area.
  - Ensure that approach paths to monitoring wells are maintained (cleared, mowed, etc.)
  - Inspect monitoring well protective casings are cleared of spider and insect nests.
  - Inspect remote sample locations for signs of natural hazards (i.e., heavy brush – ticks; snakes, etc.)

- Provide the necessary equipment to control potential emergencies (i.e., safety cans for flammable liquid storage, spill containment equipment, PPE, and emergency equipment such as portable fire extinguishers).

- Evaluate operations to ensure that necessary measures are taken to control and/or minimize the impact of emergency situations/conditions. This includes actions such as, but not limited to, securing the necessary permits and clearances such as Utility and Excavation Clearances provided by the Base and Mississippi One Call Systems; Ensuring equipment and resources are at the ready for response to incidental measures; All personnel are adequately trained in the provisions of this HASP and this Emergency Action Plan.

- Complete site characterization for all predetermined work contaminated areas to quantify and qualify the hazards associated with those areas. Based on the results obtained the areas will be demarcated and restricted to only approved personnel.

Field Crew shall:

- Identify, remove, or barricade physical hazards within the estimated work area identified by the FOL and/or the SSO.
- Follow the guidelines for control of emergency conditions
- Report any potential emergency situation to the FOL and/or the SSO.

2.4 SAFE DISTANCES AND PLACES OF REFUGE

Upon activation of the on-site emergency alarm system the following actions will occur:

- All operations will cease.
- Field personnel will note the direction of the wind based on the position of wind socks or other wind direction indicator placed at the top of the mast or excavation equipment or other elevated points within the work area (i.e., streamer, flag, etc.).
- Based on the wind direction, personnel will move cross and up wind to either the primary or secondary safe place of refuge as identified by the FOL and/or the SSO.
- All personnel will remain at this location until directed otherwise by the FOL and/or the SSO.

2.4.1 Safe Place of Refuge Selection

The FOL and/or the SSO shall identify a safe place of refuge (in the event of an emergency) on the Safe Work Permit (Example – See Section 10.2). This location will be selected and conveyed to the Field Crew as part of issuing the Safe Work Permit at the beginning of each field task. Selection will be based on the following considerations:

- A location providing telephone communications and or shelter.
- A location from which the field crews can provide site security restricting access to the emergency area, however, a point from which the field crew may direct emergency crews (i.e., intersection or gate, etc.).

In all cases this location should be positioned a sufficient (safe) distance from the operation whereas not to be impacted by the emergency. This distance is impacted by a number of conditions (i.e., tasks being conducted; chemical, physical, and toxicological properties; potential for fire and explosion; meteorological conditions; terrain).

2.4.2 Critical Operations

There are no operations being conducted under this scope of work that are considered critical and would require and individual or individuals to man during an emergency. Therefore in the event of an emergency all personnel will cease all operations and report to the safe place of refuge.

2.5 DECONTAMINATION PROCEDURES/EMERGENCY MEDICAL TREATMENT

During an evacuation, decontamination procedures will be performed only if doing so does not further jeopardize the welfare of site workers. However, it is unlikely that an emergency would occur which would require workers to evacuate the site without first performing decontamination procedures. Decontamination of medical emergencies will proceed in the following manner.

2.5.1 Non-Life Threatening Medical Incident (Bruises, Cuts, Scrapes, Etc.)

The area of clothing or suit penetration will be isolated from the decontamination procedure by removing the protective garments or clothing surrounding the area of the injury and applying a light gauze wrap and plastic cover. Decontamination for unaffected areas will proceed as per Table 5-1 of this HASP.

2.5.2 Life Threatening

- Notify off-site response agencies.
- If it will not endanger the injured individual (i.e., spinal cord injury, etc.) remove any outer PPE. Removal may require the use of bandage scissors to remove the outer garments.
- Begin life saving techniques as appropriate (CPR, cooling or warming regimens, etc.).
- Wrap the injured in a blanket for transport to the hospital.
- Engage Emergency Notification Sequence
- Follow instructions provided in Figure 2-2.

Note: One person from the field team will accompany the injured to the hospital with his/her medical data sheet, appropriate MSDSs, a copy of this HASP, and the incident forms. This person will collect as much information as possible and transfer that information to the HSM and Work Care as per the Incident

Response Protocol provided in Figure 2-2. All other personnel will engage site control/site security measures.

The SSO upon insuring care for the injured party will engage an investigation of the incident to gather as much information as possible. This includes as a minimum Who? What? Where? When? Why? And How?. This information will then be communicated to the TOM and the HSM.

2.5.3 Emergency Medical Treatment

Tetra Tech NUS and subcontractor personnel are only permitted to provide treatment to the level of their First-Aid Training.

Emergency medical treatment will be initiated under the following guarded restrictions:

- Notify the FOL and/or the SSO of the incident.
- Take the necessary precautions to prevent direct contamination with the injured person's body fluids.
  - Use surgeons gloves when handling cuts, abrasions, bites, punctures, etc. or any part of the injured person. The use of safety glasses and surgeons masks maybe necessary, if there is the potential for uncontrolled spread of body fluids.
  - Should Cardio-Pulmonary Resuscitation (CPR) be required, use a CPR Micro-Shield mouthpiece when administering CPR.

2.6 EMERGENCY ALERTING AND ACTION/RESPONSE PROCEDURES

If an emergency occurs on Base, the following procedures are to be initiated:

- Initiate an emergency notification by hand signals, voice commands, air horn, or two-way radios to the FOL/SSO. Describe to the SSO (who will serve as the Incident Coordinator) what has occurred and provide as many details as possible.

- Evacuate non-essential persons from the incident scene, engage initial response measures given the emergency type (i.e., spill response, fire extinguisher, first-aid, site control and security).

In the event that site personnel cannot control the incident through offensive and defensive measures, the FOL and/or SSO will enact the emergency notification procedures to secure additional outside assistance in the following manner:

- Call NCBC Gulfport Emergency Number

- Give the emergency operator the location of the emergency and a brief description of what has occurred.
- Stay on the phone and follow the instructions given by the operator
- The appropriate agency will be notified and dispatched
- Call Navy On-Site Representative
- Call the TOM and the HSM

If an incident occurs at outside of our designated operating areas impacting field personnel, the following procedures are to be initiated:

- Initiate an evacuation (if needed) by voice commands, hand signals, air horns, or two-way radio.
- Call Navy On-Site Representative
- Proceed to the assembly points as directed by NCBC Gulfport or other Navy personnel.

2.7 PPE AND EMERGENCY EQUIPMENT

A first aid kit, eye wash units (will be necessary at the mixing area), stretcher, and fire extinguishers will be maintained on-site at an easily accessible location and shall be immediately available for use in the event of an emergency. Based on the hazards anticipated, these incident response abatement items may be maintained at the exclusion zone of on-going operations as determine and communicated to the field crew through the Safe Work Permit. This will be at the discretion of the SSO.

The FOL and/or the SSO should ensure the First-Aid Kits are provided stocked with the necessary equipment. All first-aid kits purchased for the job-site shall be American National Standards Institute (ANSI) approved for industrial applications. Additional provisions, if not included in the First-Aid Kit such as a Micro-Shield CPR mask or resuscitation bag identified within this plan will have to be secured in addition to the kit. The SSO will determine the number of kits necessary based on the number of personnel and the number of remote operations being conducted under the scope of work. It is the SSO's responsibility to assess work site applications for specific first-aid needs based on operations being conducted.

PPE levels to be used in an emergency will not exceed those items used in the completion of identified tasks.

2.7.1 PPE Requirements - Incidental Spill of Investigative Derived Wastes (IDW)

- PVC Rain-Suits or Tyvek based on the potential for soiling work clothes during clean-up
- PVC or Neoprene Over-boots (Pant legs on the outside of the over-boots)

- Nitrile inner surgeons gloves with Nitrile outer gloves over top
- Hard hat as conditions or overhead hazards exist
- Safety Glasses
- Splash Shields as necessary

The determination to tape seams (pant legs and sleeves to boots and gloves will be decided based on existing environmental conditions (external temperatures) and the potential for heat stress. Spill equipment (identified in Section 9.0) will be maintained in the investigative derived waste storage area to support rapid response.

2.7.2 Fire Fighting

Standard field attire will be used to combat incipient fires, from a sufficient distance as not to endanger field personnel. All personnel will be trained to use the fire extinguishers on-site as part of site-specific training. Fire extinguishers will be maintained at the following locations:

- Support trailer
- On each drill rig
- At all locations which store, dispense or otherwise handle flammable or combustible liquids.

All personnel will be trained in the proper use and maintenance of the fire extinguishers provided by their employer for use. The training information to be provided during site-specific training may be found in Attachment VII of this document.

2.8 EMERGENCY CONTACTS

Prior to performing work at the site, all personnel will be briefed on the emergency procedures to be followed in the event of an incident. A mobile phone shall be available on site. Table 2-1 provides a list of emergency contacts and their corresponding telephone numbers. This table must be posted on site where it is readily available to all site personnel.

2.9 INJURY/ILLNESS REPORTING

In addition, TtNUS personnel who are injured or become ill on the job must notify appropriate company representatives. Figure 2-2 and Attachment I presents the procedure for reporting an injury/illness, and the form to use for this purpose. **If the emergency involves personnel exposures to chemicals, follow the steps in Figure 2-2.**

TABLE 2-1

EMERGENCY REFERENCE

NCBC Gulfport

	AGENCY	TELEPHONE
1	**EMERGENCY** Police Fire/Hazardous Materials Release Ambulance Services Off-Base Fire Department - Saucier Off-Base Ambulance – Harrison County Ambulance	 (228) 871-2222 (228) 871-2333 (228) 871-2444 (228) 832-5936 (228) 897-1192
2	Base Contact Mr. Gordon Crane	(228) 871-2485 Pager 1(800) 343-3472
3	Memorial Hospital at Gulfport 4500 13th Street Gulfport, Mississippi 39501-2569	(228) 867-4000
4	Task Order Manager Jason Brown – CTO 0278	(412) 921-8401
5	CLEAN Health and Safety Manager Matthew Soltis, CIH, CSP	(412) 921-8912
	Project Health and Safety Officer Donald Westerhoff, CSP	(412) 921-7821
*	Utilities (On Base) (Utility Clearances and Emergencies) Public Works Maintenance Division	(228) 871-2244
	Utilities (Public Utility Locating Service) Mississippi One Call System Inc.	1(800) 227-6477
	Chemtrec National Response Center Mississippi Regional Poison Control Center	(800) 424-9300 (800) 424-8802 (601) 354-7660
	Tetra Tech NUS, Tallahassee Office	(850) 359-9899
	Tetra Tech NUS, Pittsburgh Office	(412) 921-7090

* - The prioritization of the calling sequence has been provided in column 1. This applies to all injuries and incidents determined to be an emergency that may occur at NCBC Gulfport. The only time this will be altered is if a utility is struck and it is necessary to contact Public Works Maintenance Division to provide assistance. They then would be the first party contacted followed by Mr. Gordon Crane and so on as indicated on the list.

2.10 EMERGENCY ROUTE TO HOSPITAL (See Figure 2-2 for Map)

Directions from NCBC Gulfport:

1. Exit the Main Gate travel approximately two blocks to the traffic light.
2. Turn Left - At the traffic light (Commission Road which turns into Engram Drive)
3. Turn Right onto Broad Ave.
4. Emergency room is on the left approximately one and one half block travelling distance.

FIGURE 2-1
EMERGENCY RESPONSE PROTOCOL

The purpose of this protocol is to provide guidance for the medical management of injury situations.

In the event of a personnel injury or accident:

- Rescue, when necessary, employing proper equipment and methods.
- Give attention to emergency health problems -- breathing, cardiac function, bleeding, and shock.
- Transfer the victim to the medical facility designated in this HASP by suitable and appropriate conveyance (i.e. ambulance for serious events)
- Obtain as much exposure history as possible (a Potential Exposure report is attached).
- If the injured person is a Tetra Tech NUS employee, call the medical facility and advise them that the patient(s) is/are being sent and that they can anticipate a call from the WorkCare physician. WorkCare will contact the medical facility and request specific testing which may be appropriate. WorkCare physicians will monitor the care of the victim. Site officers and personnel should not attempt to get this information, as this activity leads to confusion and misunderstanding.
- Call WorkCare at 1-800-455-6155 and enter Extension 109, or follow the voice prompt for after hours and weekend notification and be prepared to provide:
  - Any known information about the nature of the injury.
  - As much of the exposure history as was feasible to determine in the time allowed.
  - Name and phone number of the medical facility to which the victim(s) has/have been taken.
  - Name(s) of the involved Tetra Tech NUS, Inc. employee(s).
  - Name and phone number of an informed site officer who will be responsible for further investigations.
  - Fax appropriate information to WorkCare at (714) 456-2154.
- Contact Corporate Health and Safety Department (Matt Soltis) at 1-800-245-2730.
- As data is gathered and the scenario becomes more clearly defined, this information should be forwarded to WorkCare.

WorkCare will compile the results of all data and provide a summary report of the incident. A copy of this report will be placed in each victim's medical file in addition to being distributed to appropriately designated company officials.

Each involved worker will receive a letter describing the incident but deleting any personal or individual comments. A personalized letter describing the individual findings/results will accompany this generalized summary. A copy of the personal letter will be filed in the continuing medical file maintained by WorkCare.

FIGURE 2-1 (continued)
WORKCARE
POTENTIAL EXPOSURE REPORT

Name: ______________________ Date of Exposure: __________

Social Security No.: ______________ Age: __________ Sex: ______

Client Contact: ______________________ Phone No.: __________

Company Name: ______________________________

I. Exposing Agent

Name of Product or Chemicals (if known): ______________________

Characteristics (if the name is not known)

Solid Liquid Gas Fume Mist Vapor

II. Dose Determinants

What was individual doing? ______________________

How long did individual work in area before signs/symptoms developed? __________

Was protective gear being used? If yes, what was the PPE? __________

Was their skin contact? ______________________

Was the exposing agent inhaled? ______________________

Were other persons exposed? If yes, did they experience symptoms? __________

III. Signs and Symptoms (check off appropriate symptoms)

Immediately With Exposure:

Burning of eyes, nose, or throat	Chest Tightness / Pressure
Tearing	Nausea / Vomiting
Headache	Dizziness
Cough	Weakness
Shortness of Breath	

Delayed Symptoms:

Weakness	Loss of Appetite
Nausea / Vomiting	Abdominal Pain
Shortness of Breath	Headache
Cough	Numbness / Tingling

IV. Present Status of Symptoms (check off appropriate symptoms)

Burning of eyes, nose, or throat	Nausea / Vomiting
Tearing	Dizziness
Headache	Weakness
Cough	Loss of Appetite
Shortness of Breath	Abdominal Pain
Chest Tightness / Pressure	Numbness / Tingling
Cyanosis	

Have symptoms: (please check off appropriate response and give duration of symptoms)

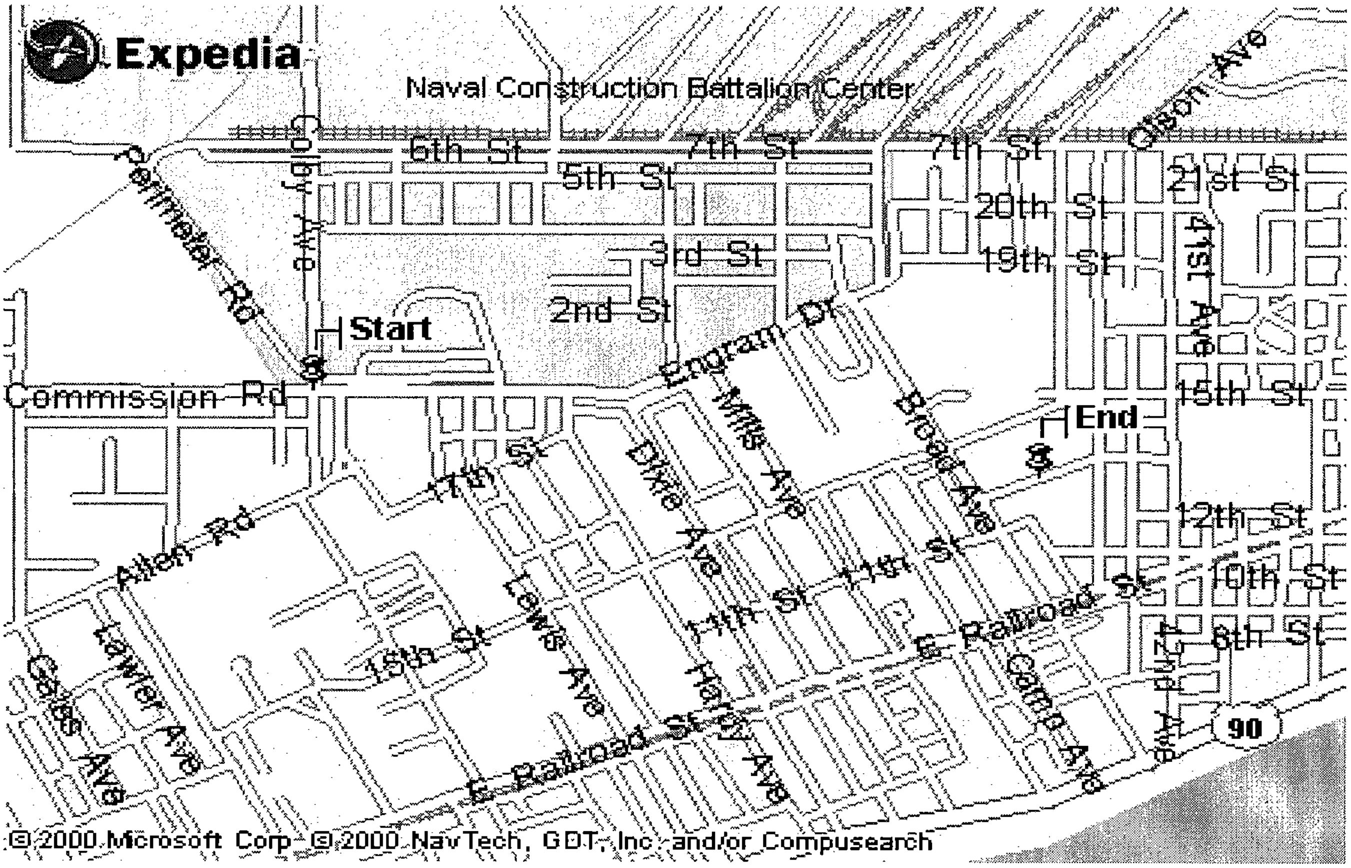
Improved: ________ Worsened: ______ Remained Unchanged: ______

V. Treatment of Symptoms (check off appropriate response)

None: __________ Self-Medicated: ______ Physician Treated: ______

FIGURE 2-2

HOSPITAL ROUTE MAP



Directions from NCBC Gulfport:

1. Exit the Main Gate travel approximately two blocks to the traffic light.
2. Turn Left - At the traffic light (Commission Road which turns into Engram Drive)
3. Turn Right onto Broad Ave.
4. Emergency room is on the left approximately one and one half block travelling distance.

3.0 SITE BACKGROUND

3.1 SITE DESCRIPTION

The Naval Construction Battalion Center (NCBC) Gulfport, Mississippi was commissioned as the homeport of the Atlantic Fleet Seabees in 1966. The Base occupies approximately 1,100 acres in the western part of Gulfport in the southeastern coastal area of Mississippi. The Navy previously used the property as a Naval Training Center and Naval Storehouse starting in 1942. Presently, four Naval Mobile Construction Battalions (NMCB) are based at Gulfport.

3.2 SITE HISTORY AND CURRENT OPERATIONS

From 1968 to 1977, nearly 23 acres of the Base were used for storage and handling of approximately 850,000 gallons of Herbicide Orange (HO) - and associated dioxins and furans (hereinafter referred to as "dioxin") - in 55-gallon drums. Spills and leaks of HO occurred during that period in the area later known as Site 8 (Areas A, B, and C). The magnitude of the release of HO and dioxin was first investigated in 1977 under the Initial HO Monitoring Program. Subsequent investigations in 1986 and 1987 delineated the horizontal and vertical extent of dioxin in soil at Site 8 to 1 microgram per kilogram (μg/kg). The 1986 and 1987 delineation work at Site 8 was followed by full-scale incineration of the soil contaminated above 1 ppb. The incineration was completed in 1988, and the resulting ash was stored in piles on Area A of Site 8.

In 1990, the USEPA changed the regulations concerning dioxin and lowered the maximum contaminant levels (MCL) for soil and groundwater below the 1mg/kg clean-up levels achieved in 1988. Subsequent investigations from 1995 through 1998 delineated the remaining dioxin in surface water and sediment, soil, and groundwater at Site 8 and at areas hydraulically connected to Site 8 (both on Base and off Base). The results of these investigations confirmed that dioxin-contaminated sediment had migrated from Site 8 into Base drainage ditches. Further, it was discovered that the contaminated sediment had migrated off Base and into the Turkey Creek Watershed north of the Base in an area called the Outfall 3 Swamp. Groundwater and soil impacted by HO-related dioxins were limited to the immediate area of Site 8 and associated ditches.

Site activities are also planned for the Rubble Disposal Area known as Site 7. Site 7 was used from 1978 to 1984 for disposal of concrete, lumber, scrap metal, and other debris. The site covers an area measuring approximately 375 by 350 feet. The disposal materials were buried just below the surface of the ground. Additionally, tree clippings, sawdust, lumber, and concrete have been placed above the groundgorund in the southeastern portion of the site. This site is now an open grassy area. Previous site investigations including groundwater and sediment sampling indicated low levels of volatile and semivolatile organic compounds, metals, and dioxins which were reported at concentrations below Federal drinking water standards.

Field activities will be conducted to support the restoration of areas impacted by previous Herbicide Orange storage at Site 8. Specific activities are described as follows.

- In November/December 2001, TtNUS excavated dioxin-impacted sediment from an on-base property (owned by H.A. Edwards) that is located north of the NCBC in swampland. Confirmation sampling performed on the remaining sediment indicated that no contamination remained above residential clean-up levels. As part of work scoped under CTO 278, TtNUS will perform road repair and shoring activities to the road that was constructed to access the Edwards property for the 2001 sediment removal.

- TtNUS will also resample two wells at Site 7 (the Rubble Disposal Area) to determine whether Site 7 served as a past HO disposal facility.

- TtNUS will excavate sediment that has been contaminated with dioxin resulting from the past storage of Herbicide Orange at the NCBS Gulfport, Mississippi. Approximately 20 cubic yards of sediment adjacent to Canal Road will be excavated prior to the start of a City of Gulfport culvert replacement project.

- Excavated sediment will be transported to Site 8A at the NCBC Gulfport.

- An SRT will be constructed at the eastern most extent of the excavation. The SRT will be installed to prevent migration of dioxin-contaminated sediment east of the SRT and will be comprised of gabion baskets wrapped in filter fabric and filled with aggregate.

4.0 SCOPE OF WORK

The following subsections discuss the specific tasks that are to be conducted as part of this scope of work as identified by CTO 278. These tasks as identified by the scope of work are the only ones addressed by this HASP. Any tasks to be conducted outside of the elements listed here will be considered a change in scope requiring modification of this document. The TOM or a designated representative will submit all requested modifications to this document to the HSM.

Specific tasks to be conducted include, but are not necessarily limited to, the following:

- Mobilization/demobilization
- Vegetation removal for the purpose of gaining access to sampling/drilling locations, excavation areas, or to conduct road repair activities.
- Soil boring and Monitoring Well installation using Hollow Stem Augers
- Excavation of dioxin-contaminated sediments
    - Roadway repair activities
    - Construction of SRT
- Multi-media Sampling
    - Groundwater sampling
    - Monitoring well development/redevelopment
    - Soil sampling – Surface and Subsurface
    - Sediment sampling
    - Surface water sampling
- Decontamination of heavy construction and sampling equipment
- Surveying
    - Wetland Delineation of Swamp
- IDW Management

Investigation-derived waste (IDW) generated during sampling activities will be containerized in United Nations (UN1A2) approved 55-gallon drums.

5.0 TASKS/HAZARDS/ASSOCIATED CONTROL MEASURES SUMMARY

Table 5-1 of this section serves as the primary portion of the site specific HASP. This table is intended to assist project personnel in the recognition of hazards and recommended procedures necessary to minimize potential exposure or injuries related to those hazards. The table also assists field team members in determining which personal protective equipment (PPE) and decontamination procedures to be used as well as appropriate air monitoring techniques and site-specific conditions. The evaluation of each task provides detailed information including anticipated hazards, recommended control measures, air monitoring recommendations, required PPE, and decontamination measures. This table must be updated if the scope of work, contaminants of concern, or pertinent conditions change.

Table 5-1 and the HASP are not meant to be stand alone documents and must be accompanied by the TtNUS Health and Safety Guidance Manual. This manual is designed to further explain supporting elements for any site specific operations as required by 29 CFR 1910.120. The Guidance Manual should be referenced for additional information regarding air monitoring instrumentation, decontamination activities, emergency response, hazard assessments, hazard communication and hearing conservation programs, medical surveillance, PPE, respiratory protection, site control measures, standard work practices, and training requirements. Many of TtNUS's SOPs are also provided in the Guidance Manual.

Safe Work Permits will be issued for all exclusion zone activities (See Section 10.2). The FOL and/or the SSO will use the elements defined in Table 5-1 as the primary reference. The FOL and/or the SSO completing the Safe Work Permit will add additional site-specific information as warranted. In situations where the Safe Work Permit is more conservative than the direction provided in Table 5-1 due to the incorporation of site-specific elements, the Safe Work Permit will be followed.

5.1 GENERAL SAFE WORK PRACTICES

In addition to the task-specific work practices identified on Table 5-1, the following general safe work practices (SWP) are to be followed when conducting work on-site. These safe work practices address a pattern of general precautions and measures for reducing risks associated with site operations. This list is not all inclusive and may be amended as necessary.

- NO eating, drinking, chewing gum or tobacco, taking medication, or smoking in contaminated or potentially contaminated areas or where the possibility for the transfer of contamination exists.
- Wash hands and face thoroughly upon leaving a contaminated or suspected contaminated area. A thorough shower and washing must be conducted as soon as possible if excessive skin contamination occurs.

- Avoid contact with potentially contaminated substances. Avoid puddles, pools, mud, or other such areas. Avoid, whenever possible, kneeling on the ground or leaning or sitting on equipment. Keep monitoring equipment away from potentially contaminated surfaces.
- Obey all instructions in the site-specific HASP.
- Take note of the location of the nearest telephone and all emergency telephone numbers. See Section 2.0, Table 2-1.
- Attend briefings on anticipated hazards, equipment requirements, safe work permits, emergency procedures, and communication methods before going on site.
- Plan and mark entrance, exit, and emergency escape routes. See Section 2.0.
- Rehearse unfamiliar operations prior to implementation.
- Buddies should maintain visual contact with each other and with other on-site team members by remaining in close proximity to assist each other in case of emergency.
- Establish appropriate Safety Zones including Support, Contamination Reduction, and Exclusion Zones.
- Minimize the number of personnel and equipment in contaminated areas (such as the Exclusion Zone). Non-essential vehicles and equipment should remain within the Support Zone.
- Establish appropriate decontamination procedures for leaving the site.
- Immediately report all injuries, illnesses, and unsafe conditions, practices, and equipment to the Site Safety Officer (SSO).
- Matches and lighters are restricted from entering in the Exclusion Zone or Contamination Reduction Zone.
- Observe coworkers for signs of toxic exposure and heat or cold stress.
- Inform co-workers of potential symptoms of illness, such as headaches, dizziness, nausea, or blurred vision.

5.2 DRILLING OPERATIONS - SAFE WORK PRACTICES

The following Safe Work Practices are to be followed when working in or around Direct Push Operations.

5.2.1 Before Drilling Operations

- Identify all underground utilities and buried structures before drilling. Use the Utility Locating and Excavation Clearance Standard Operating Procedure provided in Attachment II.

- All drilling rigs will be inspected by a Competent Person (the SSO or designee), prior to the acceptance of the equipment at the site and prior to the use of the equipment. All repairs or deficiencies identified will be corrected prior to use. The inspection will be accomplished using the Equipment Inspection Checklist provided in Attachment III. Inspection frequencies will be once every 10 day shift or following repairs.

- The work area around the point of operation will be graded to the extent possible to remove any trip hazards near or surrounding operating equipment.

- The driller's helper will establish an equipment staging and lay-down plan. The purpose of this is to keep the work area clear of clutter and slips, trips, and fall hazards. Mechanisms to secure heavy objects such as drill flights will be provided to avoid the collapse stacked equipment.

- All potentially contaminated tooling will be wrapped in polyethylene sheeting for storage and transport to the centrally located decontamination unit.

5.2.2 During Drilling Operations

- Minimize contact to the extent possible with contaminated tooling and environmental media.

- Support functions (sampling and screening stations) will be maintained a minimum distance from the drilling rig of the height of the mast plus five feet to remove these activities from within physical hazard boundaries.

- Only qualified operators and knowledgeable ground crew personnel will participate in the operation of the drill rig.

- In order to minimize contact with potentially contaminated tooling and media and to minimize lifting hazards, multiple personnel should move heavy tooling, where necessary.

- Only personnel absolutely essential to the work activity will be allowed in the exclusion zone. Site visitors will be escorted at all times.

5.2.3 After Drilling Operations

- All equipment used within the exclusion zone will undergo a complete decontamination and evaluation by the SSO to determined cleanliness prior to moving to the next location, exiting the site, or prior to down time for maintenance.

- All motorized equipment will be fueled prior to the commencement of the day's activities. During fueling operations all equipment will be shutdown and bonded to the fuel provider.

- When not in use all direct push rigs will be shutdown, emergency brakes set, and wheels chocked.

- All areas subjected to subsurface investigative methods will be restored to equal or better condition than original to remove any contamination brought to the surface and to remove any physical hazards. In situations where these hazards cannot be removed these areas will be barricaded to minimize the impact on field crews working in the area.

5.3 EXCAVATION – GENERAL SAFE WORK PRACTICES

5.3.1 Before Excavation Activities

- Identify all underground utilities and buried structures before the commencement of excavation activities. Use the Utility Locating and Excavation Clearance Standard Operating Procedure provided in Attachment II. This includes an evaluation of the intended loading areas to insure swing patterns of excavators are not nearing any overhead power lines. A minimum clearance of 20 feet must be maintained from overhead power lines unless positive control of the energy source may be obtained. See Attachment II for additional information.

- All excavation boundaries will be demarcated with appropriated signage warning of construction activities in progress. Signs shall be used also for informational purposes as well to direct personnel, to indicate PPE requirements.

- All heavy equipment will be subjected to an equipment inspection, upon arrival on-site and prior to leaving. This inspection will be recorded on the Equipment Inspection Checklist provided in Attachment III of this HASP.

- Establish appropriate traffic control procedures including flagmen, construction warning signs, high visibility cones, barrels, and protective equipment (vests and flags) and if necessary traffic permits.

- Establish traffic patterns for site equipment and the loading of trucks. This pattern should form a loop to minimize backing where possible. The placement of trucks at the loading area will employ grroundspotters to direct trucks backing into place to avoid striking people, equipment, or to avoid backing into the excavation.

- All traffic patterns for heavy equipment will be constructed to maintain traffic flow a minimum of 2 feet from unsupported walls (excavation boundaries). Groundspotters will when placing trucks at the loading area keep tires on the supported pavement to avoid sidewall collapse.

- Excavation along thoroughfares will require the use of signage, barricades and flag-persons for alteration of traffic patterns, as necessary.

- Calculate load limits based on the types of materials and level of saturation. Saturated or wet earth will weigh approximately 2910 pounds per cubic yard. A 24-ton dump truck then will take approximately 13 one-yard buckets before it is overloaded. It is critical not to overload the trucks as they have to move over public roads and properties. This is both a public safety and a structural (roadways) restriction.

- All ground personnel will be provided with reflective vests to increase visibility and air horns to signal loud trucks and heavy equipment.

- All operators travelling over public roadways will carry a Commercial Drivers License (Class B minimum) and up-to-date medical clearance.

5.3.2 During Excavation Activities

- Ground activities such as the loading of trucks should be supported with a ground spotter controlling the actions of the truck to be loaded as well as the loader. The operators will be instructed they are to follow only the instructions provided by the ground spotter unless another party is otherwise authorized.

- A decontamination station will be established at the loading and off loading areas to flush mud and dirt from the wheels and tires as well as any areas of the vehicle impacted during the loading operation.

- All access into the excavation shall be controlled and limited to authorized personnel. Access to excavations deeper than four feet or trenches shall be denied unless approved by a Competent Person in accordance with 29 CFR 1926 Subpart P.

- All routes other than those traffic patterns established shall be controlled or barricaded to focus entry and exiting through control points.

5.3.3 After Excavation Activities

- Confirmation sampling to indicate removal of contaminated materials will not occur during heavy equipment operation. Samplers will move in after hours or during break periods for obvious reasons.

- Control points for excavations to be left open and unattended shall be secured in the off hours.

- For excavations greater than four feet in depth ladders, earthen ramps, etc. will be provided for every twenty-five feet of lateral travel to provide means for entering and exiting.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Mobilization/ Demobilization activities and other miscellaneous tasks This activity includes: ▪ Site reconnaissance and utility clearance activities ▪ Set-up and construction of decon facilities and IDW areas	***Chemical hazards:*** 1) Exposure to chemical contaminants are not anticipated during this activity. However, exposure to chemicals brought onsite. . ***Physical hazards:*** 2) Lifting (strain/muscle pulls) 3) Pinches and compressions/Struck by 4) Slips, trips, and falls 5) Heavy equipment hazards (rotating equipment, hydraulic lines, etc.) 6) Vehicular and foot traffic 7) Ambient temperature extremes (heat/cold stress) ***Natural hazards:*** 8) Insect/animal bites and stings, poisonous plants, etc. 9) Inclement weather	***Chemical hazards:*** 1) The on-site Hazard Communication Program (Section 5.0 TtNUS Health and Safety Guidance Manual) will be followed. All chemicals brought onto the site by Tetra Tech NUS and subcontractor personnel will be inventoried and have an MSDS on site, on file. This effort shall include - Accurate Chemical Inventory List (Entries will match chemicals brought on-site, as the names appear on the MSDS) This list, which also includes quantities and storage locations will be provided to NCBC Gulfport Emergency Response Units upon request. - MSDS's will be maintained in a central location, accessible to all personnel. Personnel should review the MSDSs as necessary to insure they are aware of the hazards and appropriate control measures. - All containers will have labels specifying the following information: Chemical Identity (As it appears on the label, MSDS, and Chemical Inventory List) Appropriate Warning (i.e., Eye and skin irritation, flammable, etc.) Manufacturer's Name Address and Phone Number It will be the FOL and/or the SSO's responsibility to insure this is completed ***Physical hazards:*** 2) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques including - Lift with your legs, not your back, bend your knees move as close to the load as possible, and ensure good hand holds are available. - Minimize the horizontal distance to the center of the lift to your center of gravity. - Minimize turning and twisting when lifting as the lower back is especially vulnerable at this time. - Break lifts into steps if the vertical distance (from the start point to the placement of the lift) is excessive. - Plan your lifts – Place heavy items on shelves between the waist and chest; lighter items on higher shelves. - Periods of high frequency lifts or extended duration lifts should provide sufficient breaks to guard against fatigue and injury. Other considerations that may increase the susceptibility of injury due to lifting hazards include - Area available to maneuver the lift. - Area of the lift – Work place clutter, slippery surfaces - Overall physical condition 3) Keep any machine guarding in place. Do not modify tooling without manufacturer's expressed permission. - Avoid moving parts. - Use tools or equipment where necessary to avoid contacting pinch points. - Adjust machine guarding as necessary to minimize distance between guards and point of operation. - When staging equipment, insure all stacked loads, shelving, are adequately secure to avoid creating a hazard from falling objects. - All equipment will undergo a thorough equipment inspection. Mechanized and powered equipment inspections will be documented on the Equipment Inspection Checklist provided in Attachment III. All hand tools will be inspected (handle condition, cutting attachment, as applicable) to insure acceptable condition. 4) Preview work locations for unstable/uneven terrain. - Cover, guard and barricade all open pits, ditches, and floor opening as necessary near established foot paths. - Groundspotters will be employed to direct the placement of trucks at the loading area. This will avoid trucks inadvertently backing into the excavation. - The FOL and the SSO during site surveys and site preparation should identify these potential hazards. 5) All equipment will be - Inspected in accordance with OSHA and manufacturer's design. - Operated by knowledgeable operators and ground crew. It should be noted that transport of sediments in trucks in excess of 26,001 lbs will operators to have CDL (Class) to operate on city and Base thoroughfares 6) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Boom or mast + 5 feet). - All self-propelled equipment shall be equipped with movement warning systems. - The FOL and/or the SSO as a precautionary measure to remove or demarcate physical hazards shall preview traffic routes (foot and vehicular) before the commitment of personnel and resources. As part of this effort direct the placement of traffic control devices (Signs, flagpersons, etc.) - All heavy equipment operations will be supported by a ground spotter when working within confined areas or active traffic patterns. See Table 5-1 Excavation for more information on the Traffic Control Plan. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat and cold stress is provided in Section 4.0 of the TtNUS Health and Safety Guidance Manual. ***Natural hazards:*** 8) Given the location and time of the year, certain insect bites are possible. However, given this area is a light industrial area nesting areas are not anticipated. Insect repellant should be employed to control mosquitos, etc. Note: Always check with the FOL prior to using insect repellant when sampling. 9) Suspend or terminate operations until directed otherwise by SSO.	Visual observation of work practices by the SSO to minimize potential physical hazards (i.e., improper lifting, unsecured loads, noise, etc.).	Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (Steel toe/shank) - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.*	Not required. However, good work hygiene practices including Wash hands and face - Prior to lunch, breaks, when conducting hand to mouth activities. - When incidental contact with potentially contaminated media occurs. - When handling chemicals (decon solvents, oils/greases, etc.) in support of this operation.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring – Types and Action Levels	Personal Protective Equipment (Items in italics are deemed optional as conditions or the FOL or SSO dictate.)	Decontamination Procedures
Excavation of dioxin-contaminated sediment – approximately 20 cubic yards adjacent to Canal Road This activity also includes - Transport to Site 8A of NCBC Gulfport. - Construction and placement of the Sediment Recovery Trap (SRT) at the eastern extent of the excavation. - Roadway Repair	Chemical hazards: 1) Previous analytical data identified the following compounds as contaminants of concern (Air - Dust/particulate contaminants) 2,3,7,8 –TCDD (Tetrachlorodibenzo –p-dioxin) It is estimated that concentrations within the soil range between Non-detectable to 5 ppb in the soils. At this concentration TCDD represents little occupational exposure threat in an outdoor setting It is recommended that exposure (via inhalation, ingestion, or skin contact) to this contaminant be minimized due to its bio-accumulative properties. Further information on this contaminant is presented in Figure 6-1. 2) Transfer of contamination into clean areas or onto persons. Physical hazards: 3) Heavy equipment/machinery hazards (moving equipment, struck by hazards, etc.) 4) Collapse of the excavation 5) Energized systems (contact with underground or overhead utilities) 6) Noise in excess of 85 dBA 7) Vehicular and equipment traffic 8) Slips, trips, and falls 9) Ambient temperature extremes (heat stress) Natural hazards: 10) Inclement weather	Chemical hazards: 1) As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) and free product will be a universal control measure. As the material in question is a solid and/or bound to particulates, dust/particulate suppression will be the next control measure employed to minimize potential exposure. Given, the reported concentrations existing within the soils up to 5 ppb, the overall dust concentrations in the air would have to exceed 50,000 mg/m3 total dust concentration to present an exposure threat to TCDD. Traditionally, site soils are moist and present little potential for producing significant airborne dust concentrations. If visible dusts are encountered the sediment ditch will be watered down to control dusts during excavation. 2) Restrict the cross use of equipment and supplies between locations and activities without first going through a suitable decontamination. Work practices including - Excavating from the furthest point on the site and working out will minimize tracking contaminated materials over clean areas. - A rigid decontamination procedure at the loading and off-loading locations will insure materials are not carried and deposited in unaffected areas. - Sealable tail gates are required to prevent the spread of contaminated sediment during transport. If the gate cannot be sealed a liner then is required to prevent the spread of contaminated sediment on the roadways leading to Site 8A (both on and off Base. Trucks are not required to be covered/tarped unless this is necessary to prevent the spread of this material during transportation through and into unaffected areas. To insure this, a Load Inspection Checklist also provided in Attachment III will be completed for each truck leaving the excavation area enroute to the offloading area. - Any and all materials that fall to the ground will be picked up and placed in the truck. - Active surface water flow in the channel will be diverted around the excavation area. Excavation of this drainage channel will not occur during rain events that may facilitate the spread of loosen sediment through and/or around established sediment traps. Physical hazards: 3) All equipment to be employed will be: - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,601,.602), and manufacturer's design, and documented as such using Equipment Inspection Checklist provided as Attachment III. Complete the Equipment Inspection Checklist for each piece of equipment used at the site. Equipment operation will be: - Conducted by knowledgeable operators and coordinated by experienced ground crew, as applicable. - Operators operating trucks in excess of 26,001 lbs will require Commercial Drivers License (CDL). Information as it pertains to the CDL classification will be recorded on the Load Inspection Checklist (provided in Attachment III). 4) The excavation is intended to remove the top 6-inches of sediment from within the drainage channel along Canal Road. - No personnel associated with this field effort will enter any excavations without expressed permission of the SSO. - The excavator and associated transport vehicles will be maintained at a minimum distance of 2-feet from the excavation sidewall remaining on the hard surface (roadway). - Care will be taken as not to undercut roadway or roadway structures, foundations, footers, and/or support bases. - The teeth of the bucket will have a flat bar or cutting bar attached to the teeth to prevent the teeth of the backhoe from snagging an undetected utility. - Site control during excavation (See Item #7). - Site control after the excavation is complete will be accomplished through the use of drive poles and barricade tape or construction fencing to be left in place until the city can restore the area. - At no time will the operator swing the boom/bucket into adjacent traffic patterns. 5) All utility clearances shall be obtained prior to any excavation activities. Where the utility clearance cannot be obtained in a reasonable period, or not located, excavations shall proceed with extreme caution and proceed using cable and piping locators and other geophysical detection methods to avoid utility damage. Overhead utility lines will be avoided and projecting portions of site equipment will maintain a distance of at least 10 feet from any electrical lines or other overhead utility lines. Ground spotters will be used to assist equipment operators in avoiding contact with utilities and other obstacles. 6) Hearing protection will be worn by all personnel in the immediate area of the excavation operations. 7) Traffic and equipment considerations are to include the following: - Traffic control signs indicating Road Construction/lane restrictions and men working will be placed a minimum of ¼ mile prior to the work site from each direction or as indicated in the Traffic Control Plan submitted to or per specifications by the City of Gulfport. - Construction areas extending greater than 100-feet in size (excavation area and truck staging will require a minimum of two Flagpersons to control and direct vehicular traffic approaching from each direction. - Operators will be instructed not to swing boom/bucket into traffic lanes - A Ground spotter will be employed to direct the activity of the excavator and to restrict all foot traffic from within the swing pattern of the boom/bucket + 5-feet. - All equipment shall be equipped with movement warning systems. - All operators will employ safety belts and follow the City and base traffic rules. - All personnel within the defined work area will wear high visibility vests. - Trucks will maintain travel on the established routes to the off-loading area (Site 8A). - The excavator operator will exercise caution when loading the transport trucks as not to overload them. As a rule of thumb wet excavated earth will weigh ~2910 lbs/yard^3. Based on roadway weight limitations of 22-ton an average of 13 buckets (Based on a 1-yard bucket) can be loaded in a 24-ton truck without exceeding weight limitations. 8) Foot traffic in the area of the excavation should be maintained a minimum of 2-feet from the excavation sidewalls and outside the restricted area established for operating equipment. 9) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat stress concerns is provided in Section 4.0 of the TtNUS Health and Safety Guidance Manual. 10) Suspend or terminate operations until directed otherwise by SSO.	Based on observations of previous excavations in this area, real time monitoring is not necessary for this task. Site observed airborne dusts will be avoided and contact with potentially contaminated media will be avoided. Action Levels Visible dust (2 mg/m3) – Employ dust suppression (area wetting) methods when handling dry materials which have a tendency to become airborne much more easily than wet or moist materials. This action level (visible dusts) should control potential overexposure to the primary contaminant of concern TCDD. There have been no other contaminants of concern reported as determined through historical information.	All excavation operations will be performed in Level D protection, including the following articles: - Standard field dress (long pants, Sleeved shirts) - Steel toe safety shoes or work boots - Hard hat - Nitrile gloves are to be employed to handle contaminated sediment tools and equipment. Leather work gloves for general activities. - *Tyvek or washable cotton coveralls* - Impermeable boot covers for entry into drainage channels (when approved by the SSO. - High Visibility vests Personnel must closely inspect all PPE prior to beginning any on-site activities. Note: The Safe Work Permit(s) for this task (see Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. As site conditions may change, the following equipment will be maintained during all on-site activities - Fire Extinguishers for all vehicles and equipment over 1-ton rating. Upgrade to Level C protection – Not anticipated. Use dust suppression to control airborne dust emissions. Contact the PHSO if this approach does not work.	Personnel Decontamination – This decontamination procedure for Level D protection will consist of Soap/water wash and rinse of hands prior to breaks, lunch and other hand to mouth activities. (No direct contact with contaminated sediment is anticipated. If this occurs wash hands to remove visible soils/sediments. The recommendations here are in support of good work hygiene practices intended to minimize the potential ingestion of contaminated materials.) Reusable PPE such as impermeable boots shall be decontaminated where moving from areas of known contamination to areas unaffected (See Section 10.0 of this HASP). **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad. Care will be taken as not to track mud or debris onto the roads from the off-loading areas. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires cleaned off as not to track mud onto the roadways servicing this installation and off-base. Roadways shall be cleared of any debris resulting from the onsite activity.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment (*Items in italics are deemed optional as conditions or the FOL or SSO dictate.*)	Decontamination Procedures
Soil borings using Hollow Stem Auger Drill Rig	***Chemical hazards:*** 1) Previous analytical data identified the following compounds as contaminants of concern (Air - Dust/particulate contaminants) 2,3,7,8 –TCDD (Tetrachlorodibenzo –p-dioxin) It is estimated that concentrations within the soil range between Non-detectable to 5 ppb in the soils. At this concentration TCDD represents little occupational exposure threat in an outdoor setting. See Attachment VIII for mathematical calculations for determining potential airborne concentrations. It is recommended that exposure (via inhalation, ingestion, or skin contact) to this contaminant be minimized due to its bio-accumulative properties. Further information on this contaminant is presented in Figure 6-1. 2) Transfer of contamination into clean areas or onto persons ***Physical hazards:*** 3) Heavy equipment hazards (pinch/compressions points, rotating equipment, hydraulic lines, etc.) 4) Noise in excess of 85 dBA 5) Energized systems (contact with underground or overhead utilities) 6) Lifting (strain/muscle pulls) 7) Slips, trips, and falls 8) Vehicular and foot traffic 9) Ambient temperature extremes (heat/cold stress) 10) Flying projectiles ***Natural hazards:*** 11) Insect/animal bites and stings, poisonous plants, etc. 12) Inclement weather	***Chemical hazards:*** 1) As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) and free product will be a universal control measure. As the material in question is a solid and/or bound to particulates, dust/particulate suppression will be the next control measure employed to minimize potential exposure. Given, the reported concentrations existing within the soils up to 5 ppb, the overall dust concentrations in the air would have to exceed 50,000 mg/m^3 total dust concentration to present an exposure threat TCDD. Although this is unlikely even in the absence of any control measures, monitoring will be conducted to provide quantitative data regarding emissions. 2) Restrict the cross use of equipment and supplies between locations and activities without first going through a suitable decontamination. Work practices including - A rigid decontamination procedure will be employed between locations will insure materials are not carried and deposited in unaffected areas. ***Physical hazards:*** 3) All equipment will be: - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600.601.602), and manufacturer's design. All inspections will be documented using the Equipment Inspection Checklist found in Attachment III of this HASP. - Operated and supported by knowledgeable operators, and ground crew. - Used within safe work zones, with routes of approach clearly demarcated. All personnel not directly supporting this operation will remain at least 25 feet from the point of operation. See Section 9.0 of this HASP. This will be the area identified as the exclusion zone. In addition to equipment considerations, the following safe operating procedures will be incorporated: - Hydraulic masts or other projecting devices shall be at least 20 feet from overhead power sources and a minimum of 3 feet from underground utilities. - Hand signals will be established prior to the commencement of the operation. - A remote sampling device must be used to sample drill cuttings near rotating tools - Only manufacturer-approved equipment may be used in conjunction with equipment repair procedures (e.g., flight connectors). - Work areas will be kept clear of clutter. - Secure all loose articles to avoid possible entanglement during coring activities. - All self-propelled equipment shall be equipped with movement warning systems. - All personnel will be instructed in the location and operations of the emergency shut-off device(s). This device will be tested initially (and then periodically) to ensure its operational status. - Areas will be inspected prior to the movement of the drill rig and support vehicles to eliminate any physical hazards. This will be the responsibility of the FOL and/or SSO. - The drill rig and support vehicles will be moved no closer than 10 feet to unsupported side-walls of excavations and embankments. 4) Hearing protection will be used during all subsurface activities using drill rig when noise levels are > 85 dBA. (during operation). Boundaries will be established to limit noise hazard. Height of the mast + 5 feet or a minimum of 25 feet is normal. Excessive noise levels are being approach when you have to raise your voice to be heard by someone within 2 feet of your location. 5) All drilling activities will proceed in accordance with the Utility Locating and Excavation Clearance SOP in Attachment II of this HASP. All utility clearances will be obtained, in writing, and locations identified and marked prior to activities. Overhead utilities will also be identified. 6) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. 7) Preview work locations for unstable/uneven terrain. 8) Use traffic-warning signs, flag persons, and high visibility vests as determined by the SSO when working in or along traffic thoroughfares. 9) Wear appropriate clothing for weather conditions. Acceptable shelter and liquids for field crews. 10) Wear eye protection and hard hat when the drill rig is operating. Restrict all others from the area. ***Natural hazards:*** 11) Avoid nesting areas, use repellents. Report potential hazards to the SSO. See Section 6.3 of this HASP and Section 4.0 of the TtNUS Health and Safety Guidance Manual for additional information concerning natural hazards. 12) Suspend or terminate operations until directed otherwise by SSO.	Based on observations of previous drilling activities in this area, real time monitoring is not necessary for this task. Site observed airborne dusts will be avoided and contact with potentially contaminated media will be avoided. Action Levels Visible dust (2 mg/m3) – Employ dust suppression (area wetting) methods when handling dry materials which have a tendency to become airborne much more easily than wet or moist materials. This action level should control potential overexposure to the primary contaminant of concern TCDD. There have been no other contaminants of concern reported as determined through historical information.	All drilling operations will be performed in Level D protection, including the following articles: **Sampler / Oversight Personnel**: - Standard field dress (long pants, Sleeved shirts) - Steel toe safety shoes or work boots - Hard hat - *Tyvek or washable cotton coveralls* - Impermeable boot covers **Driller and Driller Helper** - Standard field attire including sleeved shirt and long pants - Safety shoes (Steel toe/shank) - Safety glasses - Nitrile inner gloves; Butyl outer gloves - Hard hat (when overhead hazard exists) - *Impermeable outer garments such as PVC Rain-suit or Saranex®, PE coated Tyvek® due to contact with contaminated tooling. An impermeable apron is acceptable due to heat stress.* - Hearing protection for high noise areas - *Reflective vest for traffic areas* **Note:** The Safe Work Permit(s) for this task (see Attachment IV of this HASP) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. Protective levels may require modification should this activity be required to be conducted within a controlled zone due to an on-going operation.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). This decontamination function may be subdivided into two locations. Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad. The sequential procedure is as follows: Stage 1: Equipment drop, remove outer protective wrapping; Decon personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable. If personnel are wearing cotton coveralls these may be vacuumed at this point. Stage 4: Disposable PPE will be removed and bagged. Stage 5: Wash face and hands Stage 6: Depending on ambient conditions, you may be required to report for medical evaluation. This evaluation consists of pulse, breathing rate, oral temperature, and body weight. This medical screening will be performed when ambient conditions dictate and during periods of acclimatization. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the onsite activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Multi-media sampling, including soils (surface and subsurface); surface water, ground water, and sediments (off-base). This task also includes well development and other misc. activities related to groundwater sampling.	***Chemical hazards:*** 1) Previous analytical data identified the following compounds as contaminants of concern (Air - Dust/particulate contaminants) 2,3,7,8 –TCDD (Tetrachlorodibenzo –p-dioxin) It is recommended that exposure (via inhalation, ingestion, or skin contact) to this contaminant be minimized due to . Further information on this contaminant is presented in Figure 6-1. See Attachment VIII for mathematical calculations for determining potential airborne concentrations. 2) Transfer of contamination into clean areas ***Physical hazards:*** 3) Noise in excess of 85 dBA 4) Lifting (strain/muscle pulls) 5) Pinches and compressions 6) Slips, trips, and falls 7) Ambient temperature extremes (heat/cold stress) 8) Vehicular and foot traffic 9) Site Characterization ***Natural hazards:*** 10) Insect/animal bites and stings, poisonous plants, etc. 11) Inclement weather	1) As a general rule, avoiding contact with contaminated media (air, water, soils, etc.) and free product will be a universal control measure. As the material in question is a solid and/or bound to particulates, dust/particulate suppression will be the next control measure employed to minimize potential exposure. Given, the reported concentrations existing within the soils up to 5 ppb, the overall dust concentrations in the air would have to exceed 50,000 mg/m^3 total dust concentration to present an exposure threat TCDD. Although this is unlikely even in the absence of any control measures, monitoring will be conducted to provide quantitative data regarding emissions. 2) Decontaminate all equipment and supplies between sampling locations and prior to leaving the site. See decontamination of heavy and sampling equipment for direction in this task. 3) When sampling at an operating Hollow Stem Auger or other type of drill rig use hearing protection. As a general rule of thumb: If you have to raise your voice to be heard by someone who is within 2 feet of your location, you may be approaching excessive noise levels (>85dBA) and hearing protection should be worn until the noise source may be positively quantified. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques (See Lifting Mobilization/Demobilization, Page 1 of 6, Table 5-1). 5) Avoid moving parts, do not remove any machine guarding. - Use tools or equipment where necessary to avoid contacting pinch points. - A remote sampling device must be used to sample drill cuttings near rotating tools. The equipment operator shall shutdown machinery if the sampler is near moving machinery parts. - Remove any snag points - Follow Safe Work Permit and Safe Work Practices for drilling procedures when working in and around the drill rigs (See Section 5.1 & 5.2). 6) Preview work locations for unstable/uneven terrain. - Ruts, roots, and other tripping hazards should be eliminated from around the rotating apparatus to minimize trips and falls when approaching the rotating tooling. - Use multiple persons and small loads to pack sampling resources to remote locations. - Construct rope ladders and other engineered assistance for traversing hills and inclines > 45°. 7) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding heat/cold stress is provided in Section 4.0 of the Health and Safety Guidance Manual. 8) Traffic and equipment considerations are to include the following: - Establish safe zones of approach (i.e. Mast or Boom + 5 feet). See Section 9 of the HASP for specific safety zones and established clearance recommendations. - All self-propelled equipment shall be equipped with movement warning systems. - When sampling along roadways, use signs to indicate men working as well flag persons, as necessary. Personnel working in and around any established traffic patterns should wear high visibility vests to increase visual recognition. 9) Work areas will be surveyed prior to committing personnel or resources. The survey will be conducted by the FOL and/or the SSO. The purpose is to identify physical and natural hazards that may impact the proposed work area. These hazards are to be identified, barricaded, or eliminated to the extent possible to minimize potential effect to field crew. 10) Avoid nesting areas, use repellents approved by the FOL. Report potential hazards to the SSO. Follow guidance presented in Appendix F, Hazard Assessment. 11) Suspend or terminate operations until directed otherwise by the SSO.	Based on observations of previous excavations in this area, real time monitoring is not necessary for this task. Site observed airborne dusts will be avoided and contact with potentially contaminated media will be avoided. Action Levels Visible dust (2 mg/m3) – Employ dust suppression (area wetting) methods when handling dry materials which have a tendency to become airborne much more easily than wet or moist materials. This action level should control potential overexposure to the primary contaminant of concern TCDD. There have been no other contaminants of concern reported as determined through historical information.	Level D protection will be utilized for the following sampling activities Surface soils, subsurface soils, surface water, groundwater, and sediments Level D - (Minimum Requirements) - Standard field attire (Sleeved shirt; long pants) - Safety shoes (steel toe/shank) - *Safety glasses* - Surgical style gloves *(double-layered if necessary)* - *Reflective vest for high traffic areas* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* - *Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists.* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* **Note:** The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** Personal decontamination will vary based on the type of sampling conducted. These are as follows: Supporting subsurface investigations at the drill rig. - Decontamination will be the same as prescribed for the drilling activity Sampling surface water, groundwater, and sediments, the following provisions will apply - Upon completion of the sampling dedicated trowels, tubing, etc. will be bagged for transport back to the central decontamination area. - PPE (gloves) will be removed and also bagged for disposal. - Handi-Wipes or similar product will be used to clean hands prior to moving to the next location. **Equipment Decontamination** All equipment used in remote sampling locations will be brought back to the central decontamination area for decontamination and re-use or decontamination and gross removal of contamination prior to disposal. Decontamination of equipment (sampling and hand tools) will proceed as indicated in the Sampling and Analysis Plan and/or Work Plan.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type And Action Levels	Personal Protective Equipment *(Items In Italics Are Deemed Optional As Conditions Or The FOL Or the SSO Dictate.)*	Decontamination Procedures
Surveying – Geographical and Geophysical Wetland delineation of the swamp is included in this tasks since similar hazards are associated with this type of work.	***Chemical hazards:*** Significant exposure to site contaminants is anticipated to be unlikely given the nature of this task. ***Physical hazards:*** 1) Slips, trips, and falls 2) Struck by 3) Ambient temperature extremes (heat stress) ***Natural hazards:*** 4) Inclement weather 5) Insect/animal bites or stings, poisonous plants, etc. 6) Water Hazards	***Physical hazards:*** 1) Preview work locations and site lines for uneven and unstable terrain. Clear necessary vegetation, establish temporary means for traversing hazardous terrain (i.e., rope ladders, etc.) 2) If hand tools (brush hooks, machetes, etc.) are necessary to clear and carry lines and bench marks to the area of operation the following precautions are recommended - Insure handles are of good construction (no cracks, splinters, loose heads/cuting apparatus. - Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade. - All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals when not in use. - All personnel will maintain a 10-foot perimeter around persons clearing brush. **Note:** It is not anticipated that trees will be required to be dropped as part of this operation and therefore will not be addressed. The additional use of chainsaws and chippers will require this HASP to be modified. 3) Wear appropriate clothing for weather conditions. Acceptable shelter and liquids for field crews. ***Natural hazards:*** 4) Suspend or terminate operations until directed otherwise by SSO 5) To combat the potential impact of natural hazards, the following actions are recommended - Avoid potential nesting areas – Preview routes, monitoring well protective casings for nests. Avoid if at all possible. - Wear light color clothes. This will allow easier detection of ticks and insects crawling on your body. It will also assist in heat stress control. - Tape pant legs to work boots to block direct access. - Use repellents – Permanone should be applied liberally to the clothing, but not the skin as it may cause irritation. Concentrate on areas where ticks and other insects may access your body such as pant cuffs, shirt to pants, and collars. - Upon exiting the high brush and wooded areas perform a close body inspection to remove any ticks or other insects that have attached to your clothing or skin. - If clearing lines in snake infested areas surveyors are recommended to wear snake chaps as a precaution. - Report potential hazards or signs and symptoms to the SSO. - Aggressive bees have been know to be a problem in this area. Avoid nesting areas (small mounds of mud) See Section 4.0 of the TtNUS Health and Safety Guidance Manual and Section 6.3 of this HASP for additional information concerning natural hazards. 6) Wear appropriate clothing for the task (rubber boots, hip waders, etc.). If the potential for drowning exists, use USCG approved personal floatation devices. The area contains varying amounts of standing water. The ground in some areas may be very soft or slippery. Whenever possible avoid potential hazardous areas (swamps, area of mud, etc.).	No air monitoring is needed given the unlikelihood that airborne contaminants will be present. The potential for exposure to site contaminants during this activity is considered minimal. As most of this activity is conducted either before or after the intrusive aspect of this operation, therefore, minimizing potential exposure.	Surveying activities shall be performed in Level D protection Level D Protection consists of the following: - Standard field dress including sleeved shirt and long pants - Safety shoes (Steel toe/shank) - Work gloves shall be worn when clearing brush. - *Safety glasses, hard hats (if working near machinery, or overhead hazards)* - *Snake chaps for heavily wooded area where encounters are likely.* - *Tyvek coveralls may be worn to provide additional protection against poisonous plants and insects, particularly ticks.* **Note:** The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task. Protective levels may require modification should this activity be required to be conducted within a controlled zone due to an on-going operation.	**Personnel Decontamination** - A structured decontamination is not required as the likelihood of encountering contaminated media is considered remote. However, survey parties should inspect themselves and one another for the presence of ticks when exiting wooded areas, grassy fields, etc. This action will be employed to stop the transfer of these insects into vehicles, homes, and offices.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Task/Operation/Location	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring Type/Action Levels	Personal Protective Equipment	Decontamination Procedures
Removal of Vegetation This task shall include the use of - Chainsaws - Chippers - Hand tools (Brush hooks, axes, etc.) However, it should be noted that most vegetation removal activities are planned to be performed using heavy machinery to clear vegetation.	***Chemical hazards:*** None anticipated ***Physical hazards:*** 2) Rotating/cutting machinery/falling objects 3) Noise 4) Biological hazards (Insect/animal bites and stings) 5) Foot and equipment traffic	***Chemical hazards:*** 1) No provisions are currently instituted for protection against chemical hazards as currently none are anticipated as part of this activity. ***Physical hazards:*** 2) All equipment to be employed will be - Inspected in accordance with Federal safety and transportation guidelines, OSHA (1926.600,.601,.602), and manufacturers design and documented as such using Equipment Inspection Checklist provided in Attachment III. - Only manufacturer approved parts may be used in repair of site equipment. - Operated by knowledgeable ground crew. - Restrictions at the operation (All personnel not directly supporting this clearance activity will remain at least 50-100 feet from the point of this operation). - Hand signals with the chipper operator or backhoe operator will be established, prior to the commencement of activities. - All personnel will be instructed in the location and operations of the emergency shut off device(s). This device will be tested initially (and then periodically) to insure its operational status. - Work areas will be kept clear of clutter to permit escape, if necessary. ***Chipper Operations*** Recommended Safety Practices: - All safety devices and controls shall be tested initially, then periodically thereafter to insure operational status. - Buddy system - At least two persons shall be in close contact with one another when operating the chipper. This will enable one to engage safety controls to assist the second should the need arise. - Work gloves, long hair, loose fitting clothing shall be taped or otherwise secured to avoid snagging and entanglement in brush or moving chipper components. - Personnel will not place their hands or feet past the entry plane of the feed hopper. - Brush and limbs shall be fed butt first, to allow these materials to sweep past the worker and avoid hooking and dragging them into the hopper and blades. - Feeding the brush and limbs should take place from the side of the feed hopper to the extent possible to enable quick and accessible activation of the emergency shut off devices. - Once the induction device takes hold of the brush or limbs, walk away, this will assist in avoiding entanglement. - Lay short materials on top of longer materials or feed shorter materials by pushing them forward using longer materials into the intake. - Direct the output into a containment structure or away from all personnel working in the area. ***Chainsaw Operations*** Recommended Safe Work Practices: - Inspect the chainsaw prior to each use. Insure the blade is adjusted and sharp, and all parts are lubricated per the manufacturer's instruction. - Test all safety devices initially and then periodically to insure operational status. - When starting, place the chainsaw on the ground or some other firm surface. Place your foot in the hand guard at the rear of the saw, grip the top handle of the saw with one hand, pull the start cord with the free hand. Never attempt to start the saw free hand or by placing on your knee. - Never cut with tip of the chain saw blade. - Plan the cut. Know where the tree will fall. Have a clear escape plan when dropping trees greater than 2 inches in girth. - Preview the tree to be dropped. Often, red wasps will nest in hollowed out trunks and in tree tops. - Do not stand between falling trees and branches and fix items or other trees. - Do not cut over your head. - Do not cut materials other than wood with the chain saw. - Wear prescribed safety equipment. - Monitor, the condition of the saw during use, make adjustments, as necessary. - When limbing a tree, to the extent possible cut from the other side of the trunk, which will serve as a shield. - Be attentive as to which way the trunk may move when removing limbs, place yourself out of the anticipated pathway when cutting. - Be attentive to movement of the trunk as an indication of the stability of the tree and brush pile. - Keep the work area free from clutter to avoid potential slip, trip, and fall hazards. If hand tools (brush hooks, machetes, etc.) are necessary to clear brush and small trees in the area of operation the following precautions are recommended: - Insure handles are of good construction (no cracks, splinters, loose heads/cutting apparatus. - Insure all cutting tools are maintained. Blades shall be sharp without knicks and gouges in the blade. - All hand tools (brush hooks, machetes, etc.) with cutting blades shall be provided with a sheath to protect individuals, when not in use. - All personnel will maintain a 10-foot perimeter around persons clearing brush. 3) Due to generated noise levels, site workers will use hearing protection. 4) Avoid insect nesting areas, employ repellents. Report potential hazards to the SSO. - A backhoe or the equivalent, or hand tools (rakes, pitch forks, etc.) shall be used to pull away brush from the brush piles pushed together to potentially avoid reaching into potential nesting areas. Hands or feet shall **not** be used for this purpose. 5) Traffic considerations Establish safe zones and routes of approach to the operation. - All personnel working in amongst equipment traffic are required to wear reflective vests for high visibility - Secure all loose articles to avoid possible entanglement. - Boundaries shall be established based on the size of trees being fallen, as well as, sufficient enough to remove personnel from associated hazards (noise, flying projectiles, etc.)	**It is not anticipated that field crews associated with this task will be overexposed to any of the site contaminants.** 4) The SSO may perform noise dosimetry to ensure the operational activities, and any contributional levels associated with the operation do not surpass the noise attenuation factors associated with the hearing protection selected. Action Levels for Noise Attenuation: - 85 dBA – Wear hearing protection When determining suitable noise protection adequacy, proceed as follows: When using a noise dosimeter measuring on the A-weighted scale 1. Obtain the TWA for the represented job classification. 2. Subtract 7db from the Noise Reduction Rating (NRR) provided on the hearing protector package. 3. Subtract the remainder from the TWA obtained. If the answer is less than 85 dBA, no additional measures shall be necessary. The hearing protection in use is suitable for the levels measured. 5) Traffic patterns will be dictated supporting onsite activities. However, regulated patterns in and about the work zones and support thereof will be established to safely control moving equipment, vehicles, and pedestrians around the area of operation.	The removal of vegetation is anticipated to be initiated in a modified Level D protection. Level D - (Minimum Requirements) For vegetation clearance activities: - Tyvek coveralls (Based on site conditions, time of the year, etc.) - Field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Safety glasses/chippers shield (For chainsaw and chipper operations) - Hardhat (when overhead hazards exists such as dropping trees, or as identified as a operation requirement) - Reflective vest for high traffic areas - Hearing protection - Work gloves - Chain saw chaps for chain saw operator In addition: - Secure all loose fitting PPE. To avoid entanglement in the chipper. - Given the time of year and recent weather conditions, ticks and other insects are not anticipated to be a problem. However, if evidence of their presence becomes obvious personnel will be required to tape pant legs to boots to deny entry, as well as, use insect repellant (Permanone) on shoe or boots, pant legs, pants to shirt seams to control access. - If conditions of heat stress are not prevalent, the use of Tyvek with taped pant legs are recommended as the light color of the coveralls makes detection easier. This table for removal of vegetation addresses minimum content based on anticipated hazards and recommended control measures. The Safe Work Permit for this activity is presented Attachment IV. This is to be completed by the FOL and/or the SSO. In the completion, these permits are to incorporate site-specific information and may actually establish requirement above and beyond, that presented in this table. In all cases, the most conservative measures will apply.	**Personnel Decontamination** It is not anticipated that site personnel engage in this task will encounter any of the associated site contaminants. Therefore, personnel decontamination will consist of - Equipment drop - Remove disposable outer protective garments, as applicable. - Wash hands and face, leave contamination reduction zone. **Note:** It is recommended when working in areas where poison ivy, oak, or sumac exist washing of exposed skins should be done with cool water to avoid opening the skins pores and carrying the oils inward. **Equipment Decontamination** General cleaning before return to storage.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring - Type and Action Levels	Personal Protective Equipment *(Items in Italics are deemed optional as conditions or the FOL or SSO dictate.)*	Decontamination Procedures
Decontamination of Sampling and Heavy Equipment It is anticipated that this activity will take place at centralized locations. Gross contamination will be removed to the extent possible at the site. Contaminated tooling then will be wrapped in polyethylene sheeting for transport to the centralized location for a full decontamination and evaluation.	***Chemical hazards:*** 1) The only chemical to pose an occupational threat during sampling was TCDD. This substance is in a solid form. It is anticipated, once wetted down are not considered to pose an occupational threat through inhalation. However, ingestion may still pose an exposure threat. Figure 6-1 provides additional information about TCDD. 2) Decontamination fluids - Liquinox (detergent); isopropanol (decontamination solvent) ***Physical hazards:*** 3) Lifting (strain/muscle pulls) 4) Noise in excess of 85 dBA 5) Flying projectiles 6) Struck by 7) Slips, trips, and falls ***Natural hazards:*** 8) Inclement weather	1) and 2) Employ protective equipment to minimize contact with site contaminants and hazardous decontamination fluids. Control potential non-occupational exposures through good work hygiene practices (i.e., avoid hand to mouth contact; wash hands and face before breaks and lunch; minimize contact with contaminated media). Obtain manufacturer's MSDS for any decontamination fluids used on-site. Solvents may only be used in well-ventilated areas, such as outdoors. Use appropriate PPE as identified on MSDS or within this HASP. All chemicals used must be listed on the Chemical Inventory for the site, and site activities must be consistent with the Hazard Communication Program provided in Section 5.0 of the TtNUS Health and Safety Guidance Manual. 3) Use multiple persons where necessary for lifting and handling heavy equipment, such as auger flights for decontamination purposes. - Employ proper lifting techniques as described in Table 5-1, Mobilization/Demobilization. 4) Wear hearing protection when operating the pressure washer and/or steam cleaner. Sound pressure levels measured during the operation of similar pieces of equipment indicate a range of 87 to 93 dBA. 5) Use eye and face protective equipment when operating the pressure washer and/or steam cleaner, due to flying projectiles. All other personnel must be restricted from the area. In addition to minimize hazards (flying projectiles, water lacerations and burns) associated with this operation, the following controls will be implemented - A Fan Tip 25° or greater will be used on pressurized systems over 3,000 psi. This will reduce the possibility of water lacerations or punctures. - Thermostat control will be in place and operational to control the temperature levels of the water where applicable. - Visual evaluations of hoses and fittings for structural defects - Construct deflection screens as necessary to control overspray and to guard against dispersion of contaminants driven off by the spray. 6) Struck by – Insure wash and drying racks are suitable construction to support heavier items such as auger flights and will secure them against falling during this process. 7) The decontamination pad should be constructed to contain wash waters generated during decontamination procedures. Temporary decontamination pads are usually 10-30 mil polyethylene or polyvinyl chloride tarp construction. Although these items when used as a liner offer containment, they also present a slipping hazard. When these temporary liners are employed, it is recommended that a light coating of sand be spread over the walking surface to provide traction. - In addition, adequate slope should be provided to the pad to permit drainage away from the object being cleaned. The collection point for wash waters should be of adequate distance that the decontamination workers do not have to walk through the wash waters while completing their tasks. - Hoses should be gathered when not in use to eliminate potential tripping hazards. 8) Suspend or terminate operations until directed otherwise by SSO.	Use visual observation and real-time monitoring instrumentation to ensure all equipment has been properly cleaned of contamination and dried.	For Heavy Equipment This applies to pressure washing and/or steam cleaning operations and soap/water wash and rinse procedures. Level D Minimum requirements: - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Chemical resistant boot covers - Nitrile outer gloves over nitrile inner gloves - Safety glasses underneath a splash shield - Hearing protection (plugs or muffs) - Hooded PVC Rainsuits or PE or PVC coated Tyvek **For sampling equipment** (trowels, Macro-Core Samplers, bailers, etc.), the following PPE is required **Note**: Consult MSDS for PPE guidance. Otherwise, observe the following. Level D Minimum requirements - - Standard field attire (Long sleeve shirt; long pants) - Safety shoes (Steel toe/shank) - Nitrile outer gloves over nitrile inner gloves - Safety glasses - Impermeable apron In the event of overspray of chemical decontamination fluids, employ PVC Rainsuits or PE or PVC coated Tyvek as necessary. **Note:** The Safe Work Permit(s) for this task (See Attachment IV) will be issued at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**Personnel Decontamination** will consist of a soap/water wash and rinse for reusable and non-reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). This decontamination function may be subdivided into two locations. Gross contamination of outer boots and outer gloves will be removed at a satellite location near the operation. Final wash and rinse will take place at the centralized decontamination pad. The sequential procedure is as follows: Stage 1: Equipment drop, remove outer protective wrapping; personnel will wipe down the outer shell and pass hand equipment through as necessary. Stage 2: Soap/water wash and rinse of outer boots and gloves Stage 3: Soap/water wash and rinse of the outer splash suit, as applicable Stage 4: Disposable PPE will be removed and bagged. Stage 5: Wash face and hands Stage 6: Depending on ambient conditions, you may be required to report for medical evaluation. This evaluation consists of pulse, breathing rate, oral temperature, and body weight. This medical screening will be performed when ambient conditions dictate and during periods of acclimatization. **Equipment Decontamination** - All heavy equipment decontamination will take place at a centralized decontamination pad utilizing a steam cleaner. Heavy equipment will have the wheels and tires cleaned along with any loose debris removed, prior to transporting to the central decontamination area. All site vehicles will have restricted access to exclusion zones, and have their wheels/tires sprayed off as not to track mud onto the roadways servicing this installation. Roadways shall be cleared of any debris resulting from the on-site activity. **Sampling Equipment Decontamination** Sampling equipment will be decontaminated as per the requirements in the Sampling and Analysis Plan and/or Work Plan. All equipment used in the exclusion zone will require a complete decontamination between locations and prior to removal from the site. The FOL or the SSO will be responsible for evaluating equipment arriving on-site, leaving the site, and between locations. No equipment will be authorized access, exit, or movement to another location without this evaluation.

TABLE 5-1

TASKS/HAZARDS/CONTROL MEASURES
NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

Tasks/Operation/ Locations	Anticipated Hazards	Recommended Control Measures	Hazard Monitoring	Personal Protective Equipment (*Items in italics are deemed optional as conditions or the FOL or SSO dictate.*)	Decontamination Procedures
IDW management and moving IDW drums to storage areas	*Chemical Hazards* 1) The only chemical to pose an occupational threat during sampling was TCDD. This substance is in a solid form. It is anticipated, once wetted down are not considered to pose an occupational threat through inhalation. However, ingestion may still pose an exposure threat. Figure 6-1 provides additional information about TCDD. 2) Transfer of contamination into clean areas *Physical hazards* 3) Noise in excess of 85 dBA 4) Lifting (muscle strains/pulls) 5) Pinches and compressions 6) Slip, trips, and falls 7) Vehicular and foot traffic 8) Ambient temperature extremes (heat/cold stress) 9) Eye and foot hazards *Natural Hazards* 10) Insect/animal bites and stings, poisonous plants, etc. 11) Inclement weather	1) Employ good work hygiene practices and PPE to control exposures to potentially contaminated media (e.g. air, water, soils). Exposure as it pertains to this task primarily applies to a release from the storage container. If a release does not occur exposure is not anticipated. 2) Decontaminate all equipment and supplies, if they become contaminated, between locations and prior to leaving the site. 3) When working near heavy equipment, use hearing protection. Refer to Attachment VI of the Guidance Manual for further information. 4) Use machinery or multiple personnel for heavy lifts. Use proper lifting techniques. Employ material handling equipment such as dolleys to move drums. 5) When placing the drums near one another keep hands from between containers to avoid pinches and compressions. 6) Preview work locations for unstable/uneven terrain. This hazard will be greatly magnified when handling heavy containers. 7) Traffic and equipment considerations are to include the following: - Secure all containers when moving to staging area. - Do not overload transport vehicles. - All activities are to be conducted consistent with the Base requirements. 8) Wear appropriate clothing for weather conditions. Provide acceptable shelter and liquids for field crews. Additional information regarding cold/heat stress concerns is provided in Section 4 of the TtNUS Health and Safety Guidance Manual. 9) Steel toe work boots should be worn when handling drums. 10) Avoid nesting areas, use commercially available insect repellents. Report potential hazards to the SSO. Follow guidance presented in Attachment II of this HASP. 11) Suspend or terminate operations until directed otherwise by SSO.	None Required The primary site contaminant may adhere to or be part of airborne dusts or particulates generated during site activities. Generation of dusts should be minimized to the greatest extent possible to avoid inhalation of contaminated dusts or particulates. Evaluation of dust concentrations will be performed by observing work conditions for visible dust clouds. Potential exposure to contaminated dust will be controlled using water suppression, by avoiding dust plumes, or evacuating the operation area until dust subsides.	Level D protection will be utilized when handling IDW. Level D - (Minimum Requirements) - Standard field attire (long sleeve shirt; long pants) - Tyvek coveralls and disposable boot covers if surface contamination is present or if the potential for soiling work attire exists. - Cotton/leather work gloves - Safety shoes (steel toe/shank) - *Safety glasses* - *Hardhat (when overhead hazards exists, or identified as a operation requirement)* *Reflective vest for high traffic areas* - *Hearing protection for high noise areas, or as directed on an operation by operation scenario.* When responding to a spill of IDW employ PPE specified in Section 10.0 Spill Control Program **Note:** The Safe Work Permit(s) for this task (see Attachment IV) will be issued and reviewed at the beginning of each day to address the tasks planned for that day. As part of this task, additional PPE may be assigned to reflect site-specific conditions or special considerations or conditions associated with any identified task.	**For spills** **Personnel Decontamination** will consist of a soap/water wash and rinse for reusable outer protective equipment (boots, gloves, PVC splash suits, as applicable). The decon function will take place at an area adjacent to the site activities. This procedure will consist of: - Equipment drop - Soap/water wash and rinse of outer boots and gloves, as applicable - Soap/water wash and rinse of the outer splash suit, as applicable - Disposable PPE will be removed and bagged. Handling IDW Closed Containers Good work Hygiene Practices including - Wash hands and face prior to hand to mouth activities.

6.0 HAZARD ASSESSMENT

The following section provides information regarding the chemical, physical, and natural hazards associated with the sites to be investigated and the activities that are to be conducted as part of the scope of work. Figure 6-1, which is included as part of this HASP, provides information on potential chemical contaminants, including exposure limits, symptoms of exposure, physical properties, and air monitoring and sampling data.

6.1 CHEMICAL HAZARDS

The potential health hazards associated with work to be conducted at NCBC Gulfport include inhalation, ingestion, and dermal contact with contaminants that may be present in shallow soils. Based on the site history and prior sampling efforts, the following have been identified as the primary classes of site contaminants, including the specific compound(s) of interest:

2,3,7,8 – Tetrachlorodibenzodioxin (TCDD)

There are theoretically 75 different possible chlorinated species. Of those the one considered most toxic is 2,3,7,8 – Tetrachlorodibenzo-p-dioxin (TCDD).

Figure 6-1 provides information on this compound including information on the toxicological, chemical, and physical properties of this substance. It is anticipated that the greatest potential for exposure to site contaminants is during intrusive activities (excavation, soil borings, sampling, etc.). Exposure to these compounds is most likely to occur through inhalation or dermal contact of contaminated soil or water, or through ingestion via hand-to-mouth contact during soil disturbance activities. For this reason, PPE and basic hygiene practices (e.g., washing face and hands before leaving site) will be extremely important. Inhalation exposure will be avoided by using appropriate PPE and engineering controls where necessary. Given the nature of planned activities and that work will be conducted outside in the open air, however, it us highly unlikely that any appreciable airborne concentrations will be present. As this material is a solid, mobility is limited to mechanical agitation. Based on this consideration care should be taken when handling dry product as it can become airborne more easily than those that are wet, thereby increasing exposure potential.

Other sources of potential chemical exposure are decontamination fluids (e.g., Liquinox, isopropanol), and analytical preservatives. For any substances brought onto the site, the SSO is responsible for instituting a site-specific Hazard Communication Program (see Section 5.0 of the TtNUS Health and Safety Guidance Manual) and for collecting the appropriate Material Safety Data Sheets (MSDS) from the chemical manufacturers/suppliers. The SSO is also responsible for completing the Safe Work Permit for the decontamination task using the appropriate MSDS and for reviewing the contents of the MSDSs and Safe Work Permit with anyone who will use these substances.

6.2 PHYSICAL HAZARDS

In addition to the chemical hazards discussed above, the following physical hazards may be present during the performance of the site activities.

- Slips, trips, and falls
- Cuts (or other injuries associated with hand tool use)
- Lifting (strain/muscle pulls)
- Ambient temperature extremes (cold and heat stress)
- Pinches and compressions
- Heavy equipment hazards (rotating equipment, hydraulic lines, etc.)
- Energized systems (contact with underground or overhead utilities)
- Vehicular and foot traffic
- Noise in excess of 85 dBA
- Flying projectiles

Each of these physical hazards is discussed in greater detail in Section 4.0 of the TtNUS health and Safety Guidance Manual. Additionally, information on the associated control measures for these hazards are discussed in Table 5-1 of this HASP. Some of these hazards and the associated control measures are discussed below due to the emphasis on incident and injury history.

6.2.1 Slips, Trips, and Falls

Conditions such as steep terrain and/or heavy vegetation may create an increased potential for slip, trip, and fall hazards.

- The safest approach to sample points will be identified and cleared to permit field crew access to sample locations.
- Establish anchor points and rope handrails for traversing/ascending/descending angles and slopes greater than 45% grade.
- Footwear with an adequate traction.
- Prepare work areas by removing tripping hazards (ruts, roots, debris). This is especially critical around rotating equipment, where a fall into the rotating apparatus could be life threatening.

Hazards of this nature are considered most predominant during mobilization/demobilization and vegetation removal.

6.2.2 Cuts or Other Injuries Associated with Hand and Power Tool Use

It is anticipated that the clearing of brush and vegetation will be performed using heavy machinery. Additionally, power tools (chainsaws) may be used to cut larger diameter trees to facilitate removal by heavy equipment. The control measures presented below will help minimize the potential for injuries related to cutting hazards.

- Wear leather or heavy cotton work gloves when using tools to protect against blisters, cuts, or other hand injuries.
- Wear eye protection (safety glasses with side shields) to protect the eyes from twigs, sticks, or flying debris.
- Clear the immediate cutting area of all personnel (radius of the tool swing area).
- Wear long pants and long-sleeved shirts to protect against abrasions.
- Wear hard hats if work will involve areas with overhead hazards (e.g., overhanging branches, falling trees).
- Wear sturdy work boots.
- Inspect all hand tools [i.e., shovel handles (cracks, splinters, etc.), brush hook handles and blade attachment points, etc.)
- Ensure all hand tools are sharp to facilitate cutting action. This will avoid persons forcing the tool to cut and increasing potential hazards.
- Use the proper tool for the intended purpose. This to will avoid potential injury possibly created through improper use.

6.2.3 Energized Systems (Contact with Underground or Overhead Utilities)

Underground utilities such as pressurized lines, water, telephone, buried utility, and high voltage power lines may be present throughout the facility. **Therefore, all subsurface activities must be conducted following the requirements of the Tetra Tech NUS SOP for "Utility Locating and Excavation Clearance (HS-1.0)"**. A copy of this SOP is provided as Attachment II. Clearance of underground and overhead utilities for each location will be coordinated with the NCBC Gulfport Public Works Department – Maintenance Division through Mr. Gordon Crane. Time lines required to obtain utility clearances are as follows:

Public Works: 10-Day advance notification

Mississippi One Call System, Inc.: 2-working day advance notification, ticket then is good for a period of 10 days before renewal is required.

Additionally, drilling operations will be conducted at a safe distance from overhead power lines as discussed in Attachment II. In certain cases, there may be a need to de-energize electrical cables using facility lockout/tagout procedures to insure electrical hazards are eliminated. For this assistance from the Public Works Maintenance Division will be sought.

6.2.4 Traffic Hazards

The excavation of the contaminated sediments along Canal Road will take place off-base on public thoroughfares. In support of this traffic control contingencies are necessary. These contingencies include

- Placement of Men Working and Traffic Lane Restriction warning signs and cones or barrels from ¼ mile to the work area from opposing directions.

- Flagpersons – The size of the work area as well as line of sight will determine the number of flagpersons required. It is recommended that if the operation area including the excavator and truck staging is over 100-feet then two flagpersons with radios are recommended. If there are turns or other aspects that impact the line of sight that this condition be considered when determining the number of flagpersons.

- Notify the following services of planned road restrictions
  - Schools in the area (In the event the restriction impacts buses and other transportation of school children)
  - Public Transportation
  - Emergency Services – Fire, ambulance, police
  - Businesses in the impacted area

- Load Inspection Checklist – See Attachment III – All trucks loaded will have a Load Inspection Checklist completed for the load prior to departing to the offloading station.

- The travel route planned is as follows:
  1. Canal Road (South) ¼ mile, turn left onto Rt. 28
  2. Rt. 28 travel 2.5 miles to 31st Street, turn right travel 1/8 mile to Pass Road, turn right
  3. Follow Pass Road through Pass Road gate to 7th Street, travel `2 miles on 7th to Site 8A

This traffic pattern should be evaluated by the FOL/SSO to insure this route does not pass through residential areas, near schools, heavy pedestrian thoroughfares. Once accepted this route is not to be altered by the truck drivers.

6.3 NATURAL HAZARDS

Insect/animal bites and stings, poisonous plants, and inclement weather are natural hazards that may be present given the location of activities to be conducted. As previously discussed, some portions of the site include vegetated areas which increases the potential for field crews to encounter ticks, bees, mosquitoes/insects, snakes, and poisonous vegetation.

6.3.1 Insect Bites and Stings

Various insects and animals may be present and should be considered. For example, fire ants present a unique situation when working outdoors in the southern portion of the United States. Their aggressive behavior and their ability to sting repeatedly can pose a unique health threat. The sting injects venom (formic acid) that causes an extreme burning sensation. Pustules form which can become infected if scratched. Allergic reactions of people sensitive to the venom include dizziness, swelling, shock and in extreme cases unconsciousness and death. People exhibiting such symptoms should see a physician. Fire ants can be identified by their habitat. They build mounds in open sunny areas sometimes supported by a wall or shrub. The mound has no external opening. The size of the mound can range from a few inches across to some which are in excess of two feet or more in height and diameter. When disturbed they defend it by swarming out and over the mound, even running up grass blades and sticks. Additionally, aggressive bees have been known to exist in this area. They live in swampy areas in nests that are on the ground and appear as small mounds of mud. Use caution when walking through marshy areas. If necessary use protective clothing (loose-fitting netting).

Insect/animal bites and stings are difficult to control given the climate and environmental setting of NCBC Gulfport. However, in an effort to minimize this hazard the following control measures will be implemented where possible.

- Commercially available bug sprays and repellents will be used whenever possible – Pesticides analytical screening includes chlordane, endrin, lindane, methoxychlor, toxaphene and heptachlor. Commercially available repellants may be used providing they don't contain substances which appear on the analytical list for pesticide analysis. Products such as DEET should not be applied directly to the skin due to potential irritation. This product, when permitted for use, should be applied over clothing articles.

- Where possible, loose-fitting and light-colored clothing with long sleeves should be worn. This will also aid in insect control by providing a barrier between the field person and the insects and to provide easy recognition of crawling insects against the lighter background. Pant legs should be secured to the work-boots using duct tape to prevent access by ticks. Mosquito nets are also recommended for use when commercially available repellents are not permitted.

- Clothing/limited body checks for ticks and other crawling insects should be conducted upon exiting heavily vegetated areas. Workers should perform a more detailed check of themselves when showering in the evening. Ticks prefer moist areas of the body (arm-pits, genitals, etc.) and will migrate to those locations.

- The FOL/SSO will preview all access routes and work areas in an effort to identify physical hazards including nesting areas in and around the work sites. These areas will be flagged and communicated to all site personnel.

- The FOL/SSO must determine if site personnel (through completion of Medical Data Sheets), suffer allergic reactions to bee and other insect stings and bites. Field crew members who are allergic to bites should have their emergency kit containing antihistamine and a preloaded syringe of epinephrine readily available.

Any allergies (insect bites, bee stings, etc.) must be reported on the Medical Data Sheet and to the SSO.

6.3.1.1 Tick and Mosquito Transmitted Illnesses and Diseases

Ticks and mosquitoes have been identified in the transmission of diseases including Lyme's disease and malaria. Warm months (Spring through early Fall) are the most predominant time for this hazard. Information concerning Lyme's Disease including recognition, evaluation, tick removal, and control is provided in Section 4.0 of the TtNUS Health and Safety Guidance Manual.

Malaria may occur when a mosquito or other infected insect sucks blood from an infected person, and the insect becomes the carrier to infect other hosts. The parasite reproduces within the mosquito, and is then passed on to another person through the biting action. Acute symptoms include chills accompanied by fever and general flu like symptoms. This generally terminates in a sweating stage. These symptoms may recur every 48 to 72 hours.

West Nile Virus

The West Nile is a type of virus that causes encephalitis or inflammation of the brain. The virus is transmitted by mosquitoes, that acquire it from infected birds. To date the West Nile virus has claimed 7 people and has infected at least 55 others. Symptoms generally occur five to 15 days following the bite of an infected mosquito, and range from a slight fever or headache to rapid onset of severe headache, high fever, stiff neck, muscle weakness, disorientation and death.

West Nile encephalitis has no specific treatment. In northern areas of the world, West Nile encephalitis cases occur primarily in the late summer or early fall. In southern climates, where temperatures are milder, West Nile encephalitis can occur year round. There is no vaccine.

6.3.2 Snakes and Other Wild Animals

Indigenous animals including snakes (poisonous and non-poisonous varieties), raccoons, and other animals native to the region may be present at the site. These animals may be encountered if work locations encroach on nesting or territories claimed by these animals. This is not generally considered to be a problem at this location as most of the activities will take place in improved areas. It is however addressed as part some tasks that may take personnel off of improved areas.

To avoid the obvious hazards conveyed as part of a direct encounter, the following actions will be taken to minimize impact on the field crews and/or operations. The FOL/SSO will preview access routes and work locations for nesting areas or signs of animal activities (tracks, foraging areas, etc.). All identified suspect areas will be communicated to the field crews. Snake chaps will be required as a precaution.

6.3.2.1 Snake Bites

All initial efforts will be directed to avoid, where possible, nesting and territorial areas. However, should field personnel come in contact with these animals and receive a bite, the following actions are necessary.

- Obtain a detailed description of the snake. This and the bite mark will enable medical personnel administering medical aid to provide prompt and correct antidotes, as necessary.

- Immobilize the bite victim to the extent possible. Physical exertion will mobilize the toxins (if poisonous varieties) from the bite point systemically through the body.

- Apply a pressure wrap (for extremities), just above and over the bite area. With a couple wraps of the pressure wrap in place over the bite area, apply a splint, and continue the application of the pressure wrap. The purpose for the splint is to restrict the movement of the extremity, this along with the pressure wrap will aid in restricting the toxins from leaving the site of the bite.

- Seek medical attention immediately.

6.3.2.2 Alligators

Although unlikely to be encountered, alligators are indigenous to south eastern portion of the United States including the eastern third of Texas and may be present in ponds, swamps, drainage channels, and other wet areas. Alligators are fairly inactive in the winter months when the water temperatures are cool; their metabolism slows down and there is little need for food. The breeding season is mostly during April and May (but may begin as early as mid-February); male and female move around more during this time. Nests are constructed by the female during June and July. The female will build a nest of leaves and vegetation up to 6 feet across and several feet high. She lays and buries her eggs in the center of this mound, allowing the warmth of the pile to incubate the eggs. Females typically lay over 50 eggs and each egg is about 3 inches long. The eggs incubate for about 9 weeks, and the female will watch and defend the nest during this time. As the young hatch, they "peep" and the female will assist them by digging them out of the nest. Newborn alligators are about 9 inches long and will stay near the female for up to a year. The female will continue to protect the young during this period.

Alligators are <u>very</u> protective of their domain during courtship and nesting. Alligators can outrun humans for short distances.

Other indication of their presence includes slides (areas marked by entering and exiting the water) and areas of cleared access for purposes of sunning (internal thermal regulation).

<u>Control Measures</u>

- Treat alligators with extreme caution. Never approach an alligator, either on land or in the water.
- If sampling involves entering areas where alligators may be present, use an "alligator-watch" as a lookout.
- Use a remote sampling device (such as a sample jar/vial on a long pole) to reach into surface water and along waters edge, **Never Use Your Hand.**
- When accessing sample locations always insure you have left yourself a clear means of retreat. Obtain the sample as quickly as possible and immediately leave the area.

6.3.3 Poisonous Plants

Various plants which can cause allergic reactions may be encountered during field work. These include, poison ivy, poison oak, and poison sumac. Contact with these plants may occur when clearing vegetation for access to work areas, or as a result of movement through these plants. An irritating, allergic reaction can occur after direct contact with the plant or indirect contact through some piece of equipment or clothing article. Oils are transferred from the plant to exposed skin, clothing, or piece of equipment. The degree of the irritating, allergic reaction can vary significantly from one person to the next.

Protective measures to control and minimize the effects of this hazard may include, but not be limited to, the following:

- Identify plants for field personnel.
  - Poison Ivy - Characterized by climbing vines, three leaf configuration ovate to elliptical in shape, deep green leaves with a reddish tint, greenish flowers, and white berries.
  - Poison Sumac - Characterized as a tall bush of the sumac family bearing compound leaves (7-13 entire leaflets), branched from a central axis, drooping, with axillary clusters of white fruit: However, these white fruits and berries may exist only during pubescent stages.
  - Poison oak - Characterized as similar to poison ivy consisting of a shrub, stems erect, 0.3 to 2.0 meters tall, leaflets consist of broad thick lobes coarsely serrated configuration, denser at the base, less so than the top.
- Protective measures may include wearing disposable garments such as Tyvek when clearing brush. These may be carefully removed and disposed of along with any oils accumulated from the plants.
- Personal Hygiene - The oils obtained from the plants will only elicit an allergic response when the person's bare skin layer is contacted. This can be aggravated when skin pores are open (perspiring), or through breaks in the skin such as cuts, nicks, scratches, etc. This can also be accomplished when using excessively hot water for cleaning the skin, which also causes pores to open. Prior to break time, lunchtime, etc. personnel should wash with cool water and soap to remove as much of the oils as possible. In heavily vegetated areas of these plants, additional measures including barrier creams and blocks may be used to prevent the oils from accessing and penetrating the skin.

All of these plants present an airborne sensitization hazard when burned. This is not to occur as part of this scope of work and therefore will not be addressed.

6.3.4 Inclement Weather

Project tasks under this Scope of Work will be performed outdoors. As a result, inclement weather may be encountered. In the event that adverse weather conditions arise (electrical storms, hurricanes, etc.), the FOL and/or the SSO will be responsible for temporarily suspending or terminating activities until hazardous conditions no longer exist.

7.0 HAZARD MONITORING – TYPES AND ACTION LEVELS

Based on available information regarding potential site contaminants and observations and air monitoring data obtained during similar operations previously performed at the site, direct read instruments are not required to evaluate airborne concentrations of site contaminants. TCDD is the primary contaminant of concern. This contaminant was evaluated based on the concentration that existed in the media to determine the exposure threat. The low concentration of TCDD present within sediments and soils associated with the site is unlikely to present an exposure concern through inhalation. As a result, dust monitoring is not required for this field operation. Extensive excavation operations previously performed at similarly contaminated areas of this site did not result in airborne concentrations of dusts. Furthermore, air monitoring conducted during these similar excavation operations did not indicate a potential exposure hazard. Furthermore, sediments and soils associated with the site (particularly the drainage ditch) are very moist and do not (based on past excavation operations at the site) generate significant airborne dusts. However, as a precautionary measure, any observed airborne dusts generated as a result of excavation operations will require the use of area wetting. Site personnel will also avoid any airborne dusts and minimize contact with potentially contaminated media. Incidental exposure via ingestion will be minimized through the use of PPE and appropriate decontamination procedures and hand/face washing prior to performing hand to mouth activities. VOCs and other contaminants that may become airborne are not considered to be potential contaminants of concern and have not been previously detected at concentrations that pose an exposure concern. Excavated soils will likely be very moist and will not generate airborne dusts. Site workers will minimize the potential for exposure through the use of contaminant avoidance and the use of PPE to minimize contact. Additionally, good decontamination and personal hygiene practices will be used to minimize the potential for incidental ingestion of site contaminants.

8.0 TRAINING/MEDICAL SURVEILLANCE REQUIREMENTS

8.1 INTRODUCTORY/REFRESHER/SUPERVISORY TRAINING

This section specifies health and safety training and medical surveillance requirements for both Tetra Tech NUS and subcontractor personnel participating in on site activities.

8.1.1 Requirements For All Field Personnel

All Tetra Tech NUS and subcontractor personnel who will engage in field associated activities as described in this HASP must have:

- Completed 40 hours of introductory hazardous waste site training or equivalent work experience as defined in OSHA Standard 29 CFR 1910.120(e).
- Completed 8-Hour Refresher Training, if the identified persons had introductory training more than 12 months prior to site work.
- Completed 8-hour Supervisory training in accordance with 29 CFR 1910.120(e)(4), if their assigned function will involve the supervision of subordinate personnel.

Documentation of introductory training or equivalent work experience, supervisory, and refresher training as well as site-specific training will be maintained at the site. Copies of certificates or other official documentation will be used to fulfill this requirement.

8.2 SITE-SPECIFIC TRAINING

Tetra Tech NUS will provide site-specific training to all Tetra Tech NUS employees and subcontractor personnel who will perform work on this project.

Figure 8-1 will be used to document the provision and content of the project-specific and associated training. All site personnel will be required to sign this form prior to commencement of site activities.

TtNUS will conduct a pre-activities training session prior to initiating site work. Additionally, a brief meeting will be held daily to discuss operations planned for that day. At the end of the workday, a short meeting may be held to discuss the operations completed and any problems encountered. This activity will be supported through the use of a Safe Work Permit System (See Section 10.10).

8.3 MEDICAL SURVEILLANCE

8.3.1 Medical Surveillance Requirements for Tetra Tech NUS and Subcontractor Personnel

All Tetra Tech NUS and subcontractor personnel participating in project field activities will have had a physical examination. All physical examinations shall meet the minimum requirements of paragraph (f) of OSHA 29 CFR 1910.120. The physical examinations will be performed to ensure all personnel are medically qualified to perform hazardous waste site work using respiratory protection.

Documentation for medical clearances will be maintained at the job site and made available, as necessary. Subcontractor personnel may use an alternative documentation for this purpose. The "Subcontractor Medical Approval Form" can be used to satisfy this requirement, or a letter from an officer of the company. The letter should state that the persons listed in the letter participate in a medical surveillance program meeting the requirements contained in paragraph (f) of Title 29 of the Code of Federal Regulations (CFR), Part 1910.120, entitled "Hazardous Waste Operations and Emergency Response." The letter should further state the following:

- The persons listed have had physical examinations under this program within the frequency as determined sufficient by their occupational health care provider
- Date of the exam
- The persons identified have been cleared, by a licensed physician, to perform hazardous waste site work and to wear positive- and negative- pressure respiratory protection.

A sample Subcontractor Medical Approval Form and form letter have been provided to all eligible subcontractors in the Bid Specification package.

8.3.2 Requirements for All Field Personnel

Each field team member, including subcontractors and visitors, entering the exclusion zone(s) shall be required to complete and submit a copy of the Medical Data Sheet also supplied to eligible subcontractors as part of the Bid Specifications Package and is available in Attachment V of this HASP. This shall be provided to the SSO, prior to participating in site activities. The purpose of this document is to provide site personnel and emergency responders with additional information that may be necessary in order to administer medical attention.

8.4 SUBCONTRACTOR EXCEPTION

If through the execution of their contract elements the subcontractor will not enter the exclusion zone and there is no potential for exposure to site contaminants, subcontractor personnel may be exempt from the training and medical surveillance requirements with the exception of Section 8.2. Examples of subcontractors who may qualify as exempt from training and medical surveillance requirements may include surveyors who perform surveying activities in site perimeter areas or areas were there is no potential for exposure to site contaminants and support or restoration services. **Use of this Subcontractor Exception is strictly limited to the authority of the CLEAN Health and Safety Manager.**

FIGURE 8-1

SITE-SPECIFIC TRAINING DOCUMENTATION

My signature below indicates that I am aware of the potential hazardous nature of performing field investigation activities at NCBC Gulfport, Mississippi and that I have received site-specific training that included the elements presented below:

- Names of designated personnel and alternates responsible for site safety and health (Section 1.2)
- Safety, health, and other hazards present on site (Table 5-1 and 6-1)
- Use of personal protective equipment (Table 5-1)
- Safe use of engineering controls and equipment (Table 5-1)
- Medical surveillance requirements (Section 8.3)
- Signs and symptoms of overexposure (Table 6-1)
- Contents of the Health and Safety Plan
- Emergency response procedures (evacuation and assembly points)(Section 2.0)
- Incipient response procedures (Section 2.0)
- Review of the contents of relevant Material Safety Data Sheets
- Review of the use of Safe Work Permits (Attachment IV)

My signature below indicates that I have been given the opportunity to ask questions and that all of my questions have been answered to my satisfaction and that the date of my training and my medical surveillance requirements indicated below are accurate.

Name (Printed and Signature)	Site-Specific Training Date	40-Hour Training (Date)	8-Hour Refresher Training (Date)	8-Hour Supervisory Training (Date)	Medical Exam

9.0 SPILL PREVENTION AND CONTAINMENT PROGRAM

9.1 SCOPE AND APPLICATION

This program applies to the single or aggregate accumulation of bulk storage materials (over 55-gallons). As the classification of certain materials such as IDW and contaminated sediment is unknown, all materials will be treated as hazardous, pending laboratory certification to the contrary. The types of materials for which this program will apply are as follows:

- Truck Transport – Trucks transporting sediment waste from Canal Road to the staging area at Site 8A
- Investigative Derived Wastes (IDW) such as decontamination fluids, soil cuttings, and purge and well development waters
- Resource Storage – Limited fuel and lubricant storage

The spill containment and control will be engaged any time there is a release of the above identified materials from a containment system or vessel. This spill containment program will be engaged in order to minimize associated hazards.

9.2 POTENTIAL SPILL AREAS

Potential spill areas will be periodically monitored in an ongoing attempt to prevent and control further potential contamination of the environment. Currently, limited areas are vulnerable to this hazard including:

- Resource deployment
- Waste transfer
- Central staging

9.3 CONTAINMENT AREAS

In order to facilitate leak and spill inspection and response, and to minimize potential hazards which may impact the integrity of the storage containers, the staging area for these substances will be structured as follows:

9.3.1 Truck Transport

To avoid potential spill and release from the trucks used to transport the contaminated sediments from Canal Road to Site 8A the following provisions will be employed:

- Complete a Load Inspection Checklist for each truck loaded. This tool will be employed as a checklist to insure truck body integrity, the use of liners, gates are sealed, leaks are not evident. This checklist is available in Attachment III.

- All incidental materials spilled during loading will be collected.

- Should a release occur, the equipment that was employed to load the truck will be employed to collect the spilled material and place in a second truck.

9.3.2 IDW

- 55 Gallon Drums (United Nations 1A2 configurations) – 4 Drums to a Pallet; labels and the retaining ring bolt and nut on the outside of each drum to facilitate easy access; Minimum 3 feet between each row of pallets. The decision to construct a bermed and lined area will be the decision of project management .

- Storage Tank – Polyethylene Construction – Tank shall be placed into a bermed enclosure of sufficient size to accommodate 110% of anticipated volume (Largest container plus 10% for rainwater and container displacement).

Regardless of container types selected, the staging area will be identified as a Satellite Storage Area with proper signage, points of contact in the event of an emergency, alternate contacts, and identification of stored material (i.e, Purge or decontamination waters, soil cuttings, etc.).

An Inventory Log will be maintained by the FOL regarding types of IDW and volumes generated. An updated Inventory List will be provided by the FOL to the designated Emergency Response Agency or Base Contact during days off and between shifts or phases of operations.

9.3.3 Flammable/POL Storage

Flammable Storage [i.e., fuels, decontamination solvents (Isopropanol)] and Petroleum/oil/lubricants (POL) will require proper dispensing containers and necessary storage for cumulative volumes in excess of 25 gallons. Storage and dispensing will comply with the following requirements:

- All fuels, which will be stored and dispensed from portable containers, will utilize safety cans.
- All portable hand held storage containers will be labeled per Hazard Communication requirements.
- Larger volumes stored for fueling equipment will be stored in approved mobile Above Ground Storage Tanks with secondary containment capable of holding the tank volume plus 10%.
- All portable flammable liquid storage tanks will be properly grounded and will have bonding capabilities for the transfer of loading and off-loading of its contents.
- All dispensing locations will be supported by a Fire Extinguisher positioned no closer than 50 feet from the storage tank, properly mounted and identified.
- The storage location will be well marked with proper signage, protective bumper poles and will have straight through access/egress for vehicles.

9.4 MATERIALS HANDLING

To minimize the hazards associated with moving drums and containers (i.e, lifting, pinch and compression points) material handling will be supported in the following manner:

- A drum cart with pneumatic tires will be required, if drums are used for IDW storage. This cart will be used to relocate drums within the staging and satellite storage location.

- In addition, a mechanized means such as a suitably equipped skid loader or back-hoe will be provided to move IDW containers from the field location to the staging and satellite storage location. This piece of equipment will also be used in site clearance and restoration as deemed appropriate and necessary.

Other means of material handling will be evaluated by the SSO based on their ability to minimize or eliminate material handling hazards.

9.5 LEAK AND SPILL DETECTION

To establish an early detection of potential spills or leaks, a periodic walk-around by the personnel staging or disposing of drums or in the Resource Deployment area will be conducted during working hours to visually determine that storage vessels are not leaking. If a leak is detected, the FOL will be notified and the Spill Containment/Control Response Plan as specified in Section 9.8 will be engaged. All inspections will be documented in the project logbook.

9.6 PERSONNEL TRAINING AND SPILL PREVENTION

All personnel will be instructed in the procedures for incipient spill prevention, containment, and collection of hazardous materials in the site-specific training. The FOL and/or the SSO will serve as the Spill Response Coordinators for this operation, should the need arise. Personnel through the course of this project will be drilled as part of testing the EAP.

9.7 SPILL PREVENTION AND CONTAINMENT EQUIPMENT

The following represents the minimum equipment that will be maintained at the staging areas at all times for the purpose of supporting this Spill Containment/Control Plan.

- Sand, clean fill, vermiculite, or other non combustible absorbent (Oil-dry)
- Extra Drums (55-gallon U.N. 1A2) should the need to transfer material from leaking containers arise.
- Pumps (Gas or Electric necessary for transferring liquids from leaking containers)/tubing
- Drum Repair Kit
- Shovels, rakes, and brooms
- Container labels
- Personal Protective Equipment
  - Nitrile outer gloves
  - Splash Shield
  - Impermeable over-boots
  - Rain suit

9.8 SPILL CONTAINMENT/CONTROL RESPONSE PLAN

This section describes the procedures the Tetra Tech NUS field personnel will employ upon the detection of a spill or leak.

- Notify the SSO or FOL immediately upon detection of a leak or spill. Activate emergency alerting procedures for that area to remove all non-essential personnel.

- Employ the personal protective equipment stored at the staging area. Take immediate actions to stop the leak or spill by plugging or patching the container or raising the leak to the highest point (portable containers) in the vessel. Spread the absorbent material in the area of the spill, covering it completely.

- Transfer the material to a new vessel; collect and containerize the absorbent material. Label the new container appropriately. Await analyses for treatment and disposal options.

- Recontainerize spills, including 2-inch of top cover (if over soils) impacted by the spill. Await test results for treatment or disposal options.

For trucks

- Isolate spill materials into a drainage trench
- Isolate ditch using sediment traps
- Collect spilled sediment along with top 6-inches

It is not anticipated that a spill will occur that the field crew cannot handle. Should this occur, notification of the appropriate Emergency Response agencies will be carried out by the FOL or SSO in accordance with the procedures specified in Section 2.0 of this HASP.

10.0 SITE OPERATIONS AND CONTROL

Site operations and control will be facilitated through the use of established work zones and security and control of those zones. These activities will minimize the impact and spread of contaminants brought to the surface through subsurface investigative methods as well as protect personnel and visitors within these zones during ongoing operations.

10.1 WORK ZONES

Tetra Tech NUS will delineate and use work zones in conjunction with decontamination procedures to prevent the spread of contaminants to other areas of the site. A three-zone approach will be used for work at this site; an Exclusion Zone, a Contamination Reduction Zone, and a Support Zone. These will be used to control access to the work areas, restricting the general public, avoiding potentials to spread any contaminants, and to protect individuals who are not cleared to enter by way of training and/or medical surveillance qualifications.

10.1.1 Exclusion Zone

An Exclusion Zone will be established at each sampling point/location. The purpose of the exclusion zone is to define a area where a more rigorous protocol for workers within what is determined to be an impact area. The impact area is that area which could be adversely impacted by either chemical or physical hazards. Exclusion zone size and dimensions will vary based on activities. Impact areas dimensions will be influenced by the following considerations:

- Physical and topographical features of the site
- Weather conditions
- Field and analytical measurements of air and environmental contaminants
- Air dispersion calculations
- Potential for explosion and dispersion
- Physical, chemical and toxicological properties of the contaminants being investigated
- Tasks to be conducted
- Decontamination procedures
- Potential for exposure

As conditions change the dimensions of the exclusion zone will change. However, the following dimensions represent a starting point from which the exclusion zones will be expanded:

- Soil Boring (Hollow stem auger). The exclusion zone for this activity will be set at the height of the mast, plus five feet surrounding the point of operation, with a minimum of 25 feet. This distance will also apply when subsurface soil sampling from behind these type rigs.

- Excavation Operations. The exclusion zone for this activity will be set at a distance equal to the maximum reach distance of the backhoe/excavator plus a distance of 10 feet. However, personnel in the vicinity of the excavation will minimized to the fewest number possible to protect against the physical hazards associated with this work. Excavator operators will be restricted to swinging booms into adjacent traffic patterns.

- Monitoring well development and sampling. The exclusion zone for this activity will be set at 10 feet surrounding the well head and discharge collection container.

- Surface soils and surface/groundwater sampling. The exclusion zone for this activity will be set at five feet surrounding the point of operation.

- Clearing and grubbing. The exclusion zone for this activity will be set at 10 feet surrounding someone with a brush hook or machete.

- Decontamination operation. The exclusion zone for this activity will be set at 25 feet surrounding the gross contamination wash and rinse as well as 25 feet surrounding the heavy equipment decontamination area.

- Investigative Derived Waste (IDW) area will be constructed and barricaded. Only authorized personnel will be allowed access.

All exclusion zones shall remain marked until the SSO has evaluated the restoration effort and has authorized changing the zone status.

Exclusion zones will be marked using barrier tape, traffic cones and/or drive poles. Signs will be posted to inform and direct site personnel and site visitors.

10.1.2 Contamination Reduction Zone

The contamination reduction zone will be split to represent two separate functions. The first function will be a control/supply point for supporting exclusion zone activities. The second function, which may take place a sufficient distance from the exclusion zone is the decontamination of personnel and heavy equipment.

In order to move from the exclusion zone to a separate location the following activities will be used:

- As samplers move from location to location during sampling activities, dedicated sampling devices and PPE will be washed of gross contamination, removed, separated, and bagged. Personnel will use hygienic wipes, such as Handy Wipes, as necessary for personnel decontamination until they can access the centralized decontamination unit. At the first available opportunity personnel will wash their face and hands. This is critical prior to breaks and lunch when contamination can be transferred to the mouth through hand to mouth contact.

- Muddy over-boots and gloves may be required to go through a gross contamination wash at the exclusion zone. These items will then be cleaned thoroughly at the centralized decontamination unit.

- Potentially contaminated tooling along with PPE will be wrapped, when necessary, for transport to the decontamination area.

- Upon completion of the assigned tasks all personnel will move through the central decontamination area to clean reusable PPE and field equipment. Based on ambient conditions medical evaluations may take place at the termination point of the decontamination line. These evaluations will include pulse rate, oral temperature, breathing rate to evaluate physiological demands on site personnel. As stated earlier, these evaluations will be based on ambient conditions and acclimation periods.

10.1.3 Support Zone

The Support Zone will consist of a field trailer, storage, lay-down areas, or some other uncontaminated, controlled point. The Support Zone for this project will include a staging area where site vehicles can be parked, equipment will be unloaded, and where food and drink containers will be maintained. In all cases, the support zones will be established in clean areas of the site.

10.2 SAFE WORK PERMITS

All Exclusion Zone work conducted in support of this project will be performed using Safe Work Permits to guide and direct field crews on a task by task basis. An example of the Safe Work Permit is included in Figure 10-1. The daily meetings conducted by the FOL/SSO will further support these work permits. The use of these permits will ensure that site-specific considerations and changing conditions are incorporated into the planning effort. All Safe Work Permits will require the signatures of either the FOL or the SSO. All personnel engaged in on-site activities must be made aware of the elements indicating levels of protection and precautionary measures to be used.

The use of these permits will establish and provide for reviewing protective measures and hazards associated with each operation. This HASP will be used as the primary reference for selecting levels of protection and control measures. The Safe Work Permit will take precedence over the HASP when more conservative measures are required based on specific site conditions.

Upon completion of the work for which the Safe Work Permit was assigned, the Safe Work Permit will be turned into the FOL or the SSO. Concerns, complaints, and suggestions may be made on the reverse of the Safe Work Permit for consideration by the FOL and/or the SSO. All permits turned in with suggestions, difficulties, or complaints will be forwarded to the PHSO for review.

The Safe Work Permit and the HASP will serve as the primary reference for work place evaluations and audits conducted to determine if the task is being conducted under the direction conveyed by the HASP and the Safe Work Permit.

10.2.1 Load Inspection Checklist

A Load Inspection Checklist will be completed for each truck loaded. See Attachment III for copies.

10.3 SITE MAP

Once the areas of contamination, access routes, topography, dispersion routes are determined, a site map will be generated and adjusted as site conditions change. This map will be posted to illustrate up-to-date information of contaminants and adjustment of zones and access points. This map will be posted at the field support trailer.

FIGURE 10-1
SAFE WORK PERMIT

Permit No. ________________ Date: ____________________________ Time: From _________ to _____

SECTION I: General Job Scope (To be filled in by person performing work)

I. Work limited to the following (description, area, equipment used): ______________________

II. Names: ______________________

III. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector __________________ ______
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☐ Level B ☐
Level C ☐ Level A ☐

Respiratory equipment required
Full face APR ☐ Escape Pack ☐
Half face APR ☐ SCBA ☐
SKA-PAC SAR ☐ Bottle Trailer ☐
Skid Rig ☐ None ☐

Modifications/Exceptions: ______________________

V. Chemicals of Concern	Action Level(s)	Response Measures

VI. Additional Safety Equipment/Procedures

Hardhat... ☐ Yes ☐ No
Safety Glasses .... ☐ Yes ☐ No
Chemical/splash goggles .... ☐ Yes ☐ No
Splash Shield .... ☐ Yes ☐ No
Splash suit/coveralls (Type:_______) .. ☐ Yes ☐ No
Steel toe/shank Workboots .... ☐ Yes ☐ No
Chemical Protective Over-boots (Type:_______) ☐ Yes ☐ No

Hearing Protection (Plugs/Muffs) .. ☐ Yes ☐ No
Safety belt/harness........................ ☐ Yes ☐ No
Radio .... ☐ Yes ☐ No
Barricades .... ☐ Yes ☐ No
Gloves (Type)................................. ☐ Yes ☐ No
Work/rest regimen.......................... ☐ Yes ☐ No

Modifications/Exceptions: ______________________

VII. Procedure review with permit acceptors

	Yes	NA
Safety shower/eyewash (Location & Use).......	☐	☐
Procedure for safe job completion..................	☐	☐
Contractor tools/equipment inspected............	☐	☐
Emergency alarms	☐	☐
Evacuation routes.....................	☐	☐
Assembly points	☐	☐

VII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Equipment and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

VIII. Additional Permits required (Hot work, confined space entry, excavation, etc.). ☐Yes ☐No
If yes, See SSO for appropriate permit

IX. Special instructions, precautions: ______________________

Permit Issued by: ______________________ Permit Accepted by: ______________________

10.4 BUDDY SYSTEM

Personnel engaged in on-site activities will practice the "buddy system" to ensure the safety of all personnel involved in this operation.

10.5 MATERIAL SAFETY DATA SHEET (MSDS) REQUIREMENTS

Tetra Tech NUS personnel will provide MSDSs for all chemicals brought on-site. The contents of these documents will be reviewed by the SSO with the user(s) of the chemical substances prior to any actual use or application or the substances on-site. The MSDSs will be maintained in a central location (i.e., temporary office) and will be available for anyone to review upon request. The SSO will be responsible for implementing a site-specific Hazard Communication Program (See Section 5.0 of the TtNUS Health and Safety Guidance Manual). This includes collection of MSDSs, creation and maintenance of an accurate Chemical Inventory Listing, addressing container labeling and personnel training issues, and other aspects of Hazard Communication.

10.6 COMMUNICATION

It is anticipated that site personnel will be working in close proximity during proposed field activities. In the event that site personnel are in isolated areas or are separated by significant distances, a supported means of communication between field crews will be utilized. Two-way radio communication devices, if needed, will be used only with NCBC Gulfport approval.

External communications will be accomplished utilizing telephones at predetermined and approved locations or through cellular phones. External communication will primarily be used for the purpose of resource and emergency resource communications. Prior to the commencement of site activities, the FOL will determine and arrange for telephone communications, if it is determined a cellular means will not be used.

The hand-held radios and cellular phones that will be used if permitted are as follows:

Motorola HT-1000	Power Output 5 watts
Cellular Phone	Power Output 5 watts

10.7 SITE VISITORS

Potential site visitors that may be encountered during the performance of the field work could include the following:

- Personnel invited to observe or participate in operations by Tetra Tech NUS.
- Regulatory personnel (i.e., DOD, MDEQ, EPA, OSHA, etc.)
- Southern Division Navy personnel
- Other authorized visitors

All non-DOD personnel working on this project are required to gain initial access to the base by coordinating with the TtNUS TOM or designee and following established base access procedures.

Once access to the base is obtained, all personnel who require access to Tetra Tech NUS work sites (areas of ongoing operations) will be required to obtain permission from the FOL and the Base Contact. Upon gaining access to the work site, all site visitors wishing to observe operations in progress will be required to meet the minimum requirements as stipulated below.

- All site visitors will be routed to the FOL, who will sign them into the field logbook. Information to be recorded in the logbook will include the individuals name (proper identification required), who they represent, and the purpose for the visit. **The FOL is responsible for ensuring that site visitors are escorted at all times.**

- All site visitors will be required to produce the necessary information supporting clearance on to the site. This includes information attesting to applicable training (40-hours of HAZWOPER training required for all Southern Division Navy Personnel), and medical surveillance as stipulated in Section 8.3, of this document. In addition, to enter the sites operational zones during planned activities, all visitors will be required to first go through site-specific training covering the topics stipulated in Section 8.2 of this HASP.

Once the site visitors have completed the above items they will be permitted to enter the site and applicable operational areas. All visitors are required to observe the protective equipment and site restrictions in effect at the work areas visited. Any and all visitors not meeting the requirements as stipulated in this plan for site clearance will not be permitted to enter the site operational zones during planned activities. Any incidence of unauthorized site visitation will cause all on-site activities to be terminated until that visitor can be removed. Removal of unauthorized visitors will be accomplished with support form the Base Contact, if necessary. At a minimum, the Base Contact will be notified of any unauthorized visitors.

10.8 SITE SECURITY

As this activity will take place at a Navy facility, the first line of security will be provided by the base gate restricting the general public. The second line of security will take place at the work site referring interested parties to the FOL and Base Contact.

Security at the work areas will be accomplished using field personnel. This is a multiple person operation, involving multiple operational zones. Tetra Tech NUS personnel will retain complete control over active operational zones.

The Base Contact will serve as the focal point for base personnel and interested parties and will serve as the primary enforcement contact.

10.9 SANITATION AND BREAK AREAS

This section will address the following items:

- Toilets
- Potable water
- Showers and change rooms
- Break Areas

10.9.1 Toilets

One toilet will be provided for every 20 people. All toilets will be unisex and will have locking doors. The toilet provided will either be a chemical toilet and service provider or the flush toilet associated with a predetermined location.

10.9.2 Potable Water

Potable water as well as electrolyte balance sports drinks such as Gatorade will be provided to the field crews for fluid replacement. Storage and dispensing will proceed as follows:

- All containers will be clean and replenished daily.

- All containers will clearly marked as to their contents (Potable Water – Drinking Water Only; Gatorade, etc.).

- Dispensing locations will be placed in identified break areas within the support zone. The most likely location will be a break trailer. This will serve as an area for cooling or warming as well as an identified food and drink consumption area.

- If larger containers are used, dispensing cups will be provided.

- The coolers used for storage of potable drinks and cups will be stored in plastic bags away from potentially contaminating materials.

Fluid intake recommendations will be made based on the medical evaluations conducted at the end of the decontamination process.

10.9.3 Showers and Change Rooms

Based on this scope and duration of this project shower facilities and locker rooms will not be provided.

10.9.4 Break Areas

Suitable locations will be provided for field personnel for the following use:

- Break areas for food and drink consumption
- Areas suitable for warming and cooling regimens
- Areas suitable for Safety Meetings

This location will be either the project trailer, or its own separate trailer based on the crew size. This area will be climate control to provide suitable shelter to combat heat or cold stress.

11.0 CONFINED SPACE ENTRY

It is not anticipated, under the proposed scope of work, that confined space and permit-required confined space activities will be conducted. **Therefore, personnel under the provisions of this HASP are not allowed, under any circumstances, to enter confined spaces**. A confined space means a space that:

- Is large enough and so configured that an employee can bodily enter and perform assigned work.
- Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry).
- Is not designed for continuous employee occupancy.

A Permit-Required Confined Space is a confined space that has one or more of the following characteristics:

- Contains or has a potential to contain a hazardous atmosphere.
- Contains a material that has the potential to engulf an entrant.
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor which slopes downward and tapers to a smaller cross-section.
- Contains any other recognized, serious, safety or health hazard.

For further information on confined space, consult the Health and Safety Guidance Manual or call the PHSO. If confined space operations are to be performed as part of the scope of work, detailed procedures and training requirements will have to be addressed, and the HSM will have to be notified.

12.0 MATERIALS AND DOCUMENTATION

The TtNUS FOL shall ensure the following materials/documents are taken to the project site and used when required.

- A complete copy of this HASP
- Health and Safety Guidance Manual
- Incident Reports
- Medical Data Sheets
- Material Safety Data Sheets for all chemicals brought on site, including decontamination solutions, fuels, sample preservatives, calibration gases, etc.
- A full-size OSHA Job Safety and Health Poster (posted in the site trailers)
- Training/Medical Surveillance Documentation Form (Blank)
- Emergency Reference Information (Section 2.0, extra copy for posting)

12.1 MATERIALS TO BE POSTED OR MAINTAINED AT THE SITE

The following documentation is to be posted or maintained at the site for quick reference purposes. In situations where posting these documents is not feasible, (such as no office trailer), these documents should be separated and immediately accessible.

Chemical Inventory Listing (posted) - This list represents all chemicals brought on-site, including decontamination solutions, sample preservations, fuel, etc.. This list should be posted in a central area.

MSDSs (maintained) - The MSDSs should also be in a central area accessible to all site personnel. These documents should match all the listings on the chemical inventory list for all substances employed on-site. It is acceptable to have these documents within a central folder and the chemical inventory as the table of contents.

The OSHA Job Safety & Health Protection Poster (posted) - this poster, as directed by 29 CFR 1903.2 (a)(1), should be conspicuously posted in places where notices to employees are normally posted. Each FOL shall ensure that this poster is not defaced, altered, or covered by other material.

Site Clearance (maintained) - This list is found within the training section of the HASP (See Figure 8-2). This list identifies all site personnel, dates of training (including site-specific training), and medical surveillance. The lists indicates not only clearance but also status. If personnel do not meet these requirements, they do not enter the site while site personnel are engaged in activities.

Emergency Phone Numbers and Directions to the Hospital(s) (posted) - This list of numbers and directions will be maintained at all phone communications points and in each site vehicle.

Medical Data Sheets/Cards (maintained) - Medical Data Sheets will be filled out by on-site personnel and filed in a central location. The Medical Data Sheet will accompany any injury or illness requiring medical attention to the medical facility. A copy of this sheet or a wallet card will be given to all personnel to be carried on their person.

Hearing Conservation Standard (29 CFR 1910.95) (posted) - this standard will be posted anytime hearing protection or other noise abatement procedures are employed.

Personnel Monitoring (maintained) - All results generated through personnel sampling (levels of airborne toxins, noise levels, etc.) will be posted to inform individuals of the results of that effort.

Placards and Labels (maintained) - Where chemical inventories have been separated because of quantities and incompatibilities, these areas will be conspicuously marked using Department of Transportation (DOT) placards and acceptable (Hazard Communication 29 CFR 1910.1200(f)) labels.

The purpose of maintaining or posting this information, as stated above, is to allow site personnel quick access. Variations concerning location and methods of presentation are acceptable, providing the objection is accomplished.

13.0 GLOSSARY

ACGIH	American Conference of Governmental Industrial Hygienists
APR	Air Purifying Respirators
AOC	Area of Concern
CERCLA	Comprehensive Environmental Response Compensation, and Liability Act
CFR	Code of Federal Regulations
CNS	Central Nervous System
CRZ	Contamination Reduction Zone
CTO	Contract Task Order
DOD	Department of Defense
DOT	Department of Transportation
DPT	Direct-Push Technology
EPA	Environmental Protection Agency
FFA	Federal Facilities Agreement
eV	Electron Volts
FID	Flame Ionization Detector
FOL	Field Operations Leader
FS/BA	Feasibility Study / Brownfield Agreement
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	High Efficiency Particulate Air
HSM	Health and Safety Manager
IDW	Investigation-derived Waste
LEL/O_2	Lower Explosive Limit/Oxygen
MSDS	Material Safety Data Sheet
N/A	Not Available
NCBC	Naval Construction Battalion Center
NAS	Naval Air Station
NIOSH	National Institute Occupational Safety and Health
OSHA	Occupational Safety and Health Administration (U.S. Department of Labor)
PEL	Permissible Exposure Limit
PHSO	Project Health and Safety Officer
PID	Photo Ionization Detector
PPE	Personal Protective Equipment
RIFS	Remedial Investigation and Feasibility Study

SAP	Sampling and Analysis Plan
SCBA	Self Contained Breathing Apparatus
SOPs	Standard Operating Procedures
SRT	Sediment Recovery Trap
SSO	Site Safety Officer
STEL	Short Term Exposure Limit
SVOC	Semi-volatile Organic Compounds
TCDD	Tetrachlorodibenzodioxin
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
TWA	Time Weighted Average
UV	Ultra Violet
VOCs	Volatile Organic Compounds

ATTACHMENT I

INJURY/ILLNESS PROCEDURE
AND REPORT FORM

case no. __________

TETRA TECH NUS, INC.

INJURY/ILLNESS PROCEDURE
WORKER'S COMPENSATION PROGRAM

WHAT YOU SHOULD DO IF YOU ARE INJURED OR DEVELOP AN ILLNESS AS A RESULT OF YOUR EMPLOYMENT:

- If injury is minor, obtain appropriate first aid treatment.
- If injury or illness is severe or life threatening, obtain professional medical treatment at the nearest hospital emergency room.
- If incident involves a chemical exposure on a project work site, follow instructions in the Health & Safety Plan.
- Immediately report any injury or illness to your supervisor or office manager. In addition, you must contact your Human Resources representative, Marilyn Duffy at (412) 921-8475, and the Corporate Health and Safety Manager, Matt Soltis at (412) 921-8912 **within 24 hours**. You will be required to complete an Injury/Illness Report (attached). You may also be required to participate in a more detailed investigation from the Health Sciences Department.
- If further medical treatment is needed, The Hartford Network Referral Unit will furnish a list of network providers customized to the location of the injured employee. These providers are to be used for treatment of Worker's Compensation injuries subject to the laws of the state in which you work. Please call Marilyn Duffy at (412) 921-8475 for the number of the Referral Unit.

ADDITIONAL QUESTIONS REGARDING WORKER'S COMPENSATION:

Contact your local human resources representative, corporate health and safety coordinator, or Corporate Administration in Pasadena, California, at (626) 351-4664.

Worker's compensation is a state-mandated program that provides medical and disability benefits to employees who become disabled due to job related injury or illness. Tetra Tech, Inc. and its subsidiaries (Tetra Tech or Company) pay premiums on behalf of their employees. The type of injuries or illnesses covered and the amount of benefits paid are regulated by the state worker's compensation boards and vary from state to state. Corporate Administration in Pasadena is responsible for administering the Company's worker's compensation program. The following is a general explanation of worker's compensation provided in the event that you become injured or develop an illness as a result of your employment with Tetra Tech or any of its subsidiaries. Please be aware that the term used for worker's compensation varies from state to state.

WHO IS COVERED:

All employees of Tetra Tech, whether they are on a full-time, part-time or temporary status, working in an office or in the field, are entitled to worker's compensation benefits.

All employees must follow the above injury/illness reporting procedures. Consultants, independent contractors, and employees of subcontractors are not covered by Tetra Tech's Worker's Compensation plan.

WHAT IS COVERED:

If you are injured or develop an illness caused by your employment, worker's compensation benefits are available to you subject to the laws of the state you work in. Injuries do not have to be serious; even injuries treated by first aid practices are covered and must be reported. Please note that if you are working out-of-state and away from your home office, you are still eligible for worker's compensation benefits.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT

To: ______________________________
Subsidiary Health and Safety Representative

cc: ______________________________
Workers Compensation Administrator

Project name: ______________________________

Project number: ______________________________

Prepared by: ______________________________

Position: ______________________________

Office: ______________________________

Telephone number: ______________________________

Fax number: ______________________________

Information Regarding Injured or Ill Employee

Name: ______________________________

Home address: ______________________________

____

Home telephone number: ______________________________

Occupation (regular job title): ______________________________

Department: ______________________________

Office: ______________________________

Gender: M ☐ F ☐ No. of dependents: ________

Marital status: ______________________________

Date of birth: ______________________________

Social security number: ______________________________

Date of Accident: ______________________________

Time Employee Began Work: ______________________________

Time of Accident: ____________ a.m. ☐ p.m. ☐

☐ Check if time cannot be determined

Location of Incident

Street address: ______________________________

City, state, and zip code: ______________________________

County: ______________________________

Was place of accident or exposure on employer's premises? Yes ☐ No ☐

Information About the Incident

What was the employee doing just before the incident occurred? Describe the activity as well as the tools, equipment, or material the employee was using. Be specific. Examples: "Climbing a ladder while carrying roofing materials"; "Spraying chlorine from hand sprayer"; "Daily computer key-entry"

What Happened? Describe how the injury occurred. Examples: "When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time"

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Information About the Incident (Continued)

What was the injury or illness? Describe the part(s) of the body affected and how it was affected. Be more specific than "hurt," "pain," or "sore." Examples "Strained back"; "Chemical burn, right hand"; "Carpal tunnel syndrome, left wrist"

Describe the Object or Substance that Directly Harmed the Employee: Examples: "Concrete floor"; "Chlorine"; "Radial arm saw." If this question does not apply to the incident, write "Not applicable."

Did the employee die? Yes ☐ No ☐ Date of death: ____________________

Was employee performing regular job duties? Yes ☐ No ☐

Was safety equipment provided? Yes ☐ No ☐ Was safety equipment used? Yes ☐ No ☐

Note: Attach any police reports or related diagrams to this report.

Witness (Attach additional sheets for other witnesses.)

Name: ____________________

Company: ____________________

Street address: ____________________

City: ____________________ State: __________ Zip code: __________

Telephone number: ____________________

Medical Treatment Required? ☐ Yes ☐ No ☐ First aid only

Name of physician or health care professional: ____________________

If treatment was provided away from the work site, provide the information below.

Facility name: ____________________

Street address: ____________________

City: ____________________ State: __________ Zip code: __________

Telephone number: ____________________

Was the employee treated in an emergency room? ☐ Yes ☐ No

Was the employee hospitalized over night as an in-patient? ☐ Yes ☐ No

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

Corrective Action(s) Taken by Unit Reporting the Accident:

Corrective Action Still to be Taken (by whom and when):

Name of Tetra Tech employee the injury or illness was first reported to: ______________________

Date of Report: ______________________ **Time of Report:** ______________________

I have reviewed this investigation report and agree, to the best of my recollection, with its contents.

______________________ ______________________
Printed Name of Injured Employee Telephone Number

______________________ ______________________
Signature of Injured Employee Date

The signatures provided below indicate that appropriate personnel have been notified of the incident.

Title	Printed Name	Signature	Telephone Number	Date
Office Manager				
Project Manager				
Site Safety Coordinator or Office Health and Safety Representative				

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

TETRA TECH, INC.

ACCIDENT AND ILLNESS INVESTIGATION REPORT (Continued)

To Be Completed by the Subsidiary Health and Safety Representative

Classification of Incident:

☐ Injury ☐ Illness

Result of Incident:

☐ First aid only

☐ Days away from work

☐ Remained at work but incident resulted in job transfer or work restriction

☐ Incident involved days away and job transfer or work restriction

☐ Medical treatment only

No. of days away from work ____________________

Date employee left work ____________________

Date employee returned to work ____________________

No. of days placed on restriction or job transfer: ____________________

OSHA Recordable Case Number ____________________

To Be Completed by Human Resources

Social security number: ____________________

Date of hire: ____________________ Hire date for current job: ____________________

Wage information: $ __________ per ☐ Hour ☐ Day ☐ Week ☐ Month

Position at time of hire: ____________________

Current position: ____________________ Shift hours: ____________________

State in which employee was hired: ____________________

Status: ☐ Full-time ☐ Part-time Hours per week: ________ Days per week: ________

Temporary job end date: ____________________

To Be Completed during Report to Workers Compensation Carrier

Date reported: ____________________ Reported by: ____________________

Confirmation number: ____________________

Name of contact: ____________________

Field office of claims adjuster: ____________________

This form contains information relating to employee health and must be used in a manner that protects the confidentiality of the employee to the extent possible while the information is being used for occupational safety and health purposes.

ATTACHMENT II

STANDARD OPERATING PROCEDURE
FOR
UTILITY LOCATING AND EXCAVATION CLEARANCE

TETRA TECH NUS, INC.	STANDARD OPERATING PROCEDURES	Number HS-1.0	Page 1 of 11
		Effective Date 03/00	Revision 1
		Applicability Tetra Tech NUS, Inc.	
		Prepared Health & Safety	
Subject UTILITY LOCATING AND EXCAVATION CLEARANCE		Approved D. Senovich DS	

TABLE OF CONTENTS

1.0 PURPOSE

Utilities such as electric service lines, natural or propane gas lines, water and sewage lines, telecommunications, and steam lines are very often in the immediate vicinity of work locations. Contact with underground or overhead utilities can have serious consequences including employee injury/fatality, property and equipment damage, substantial financial impacts, and loss of utility service to users.

The purpose of this procedure is to provide minimum requirements and technical guidelines regarding the appropriate procedures to be followed when performing subsurface and overhead utility locating services. It is the policy of Tetra Tech NUS, Inc. (TtNUS) to provide a safe and healthful work environment for the protection of our employees. The purpose of this Standard Operating Procedure (SOP) is to aid in achieving the objectives of the TtNUS Utility Locating and Clearance Policy. The TtNUS Utility Locating and Clearance Policy must be reviewed by anyone potentially involved with underground or overhead utility services.

2.0 SCOPE

This procedure applies to all TtNUS field activities where there may be potential contact with underground or overhead utilities. This procedure provides a description of the principles of operation, instrumentation, applicability, and implementability of typical methods used to determine the presence or absence of utility services. This procedure is intended to assist with work planning and scheduling, resource planning, field implementation, and subcontractor procurement. Utility locating and excavation clearance requires site-specific information prior to the development of detailed operating procedures. This guidance is not intended to provide a detailed description of methodology and instrument operation. Specialized expertise during both planning and execution of several of the geophysical methods may also be required.

3.0 GLOSSARY

Electromagnetic Induction (EMI) Survey - A geophysical exploration method whereby electromagnetic fields are induced in the ground and the resultant secondary electromagnetic fields are detected as a measure of ground conductivity.

Magnetometer – A device used for precise and sensitive measurements of magnetic fields.

Magnetic Survey – A geophysical survey method that depends on detection of magnetic anomalies caused by the presence of buried ferromagnetic objects.

Metal Detection – A geophysical survey method that is based on electromagnetic coupling caused by underground conductive objects.

Vertical Gradiometer – A magnetometer equipped with two sensors that are vertically separated by a fixed distance. It is best suited to map near surface features and is less susceptible to deep geologic features.

Ground Penetrating Radar – Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture.

4.0 RESPONSIBILITIES

Project Manager (PM)/Task Order Manager (TOM) - Responsible for ensuring that all field activities are conducted in accordance with this procedure and the TtNUS Utility Locating and Clearance Policy.

Site Manager (SM)/Field Operations Leader (FOL) - Responsible for the onsite verification that all field activities are performed in compliance with approved SOPs or as otherwise directed by the approved project plan(s).

Site Health & Safety Officer (SHSO) – Responsible to provide technical assistance and verify full compliance with this SOP and the TtNUS Utility Locating and Clearance Policy. The SHSO is also responsible for reporting any deficiencies to the Corporate Health and Safety Manager (HSM) and to the PM/TOM.

Health & Safety Manager (HSM) – Responsible for preparing, implementing, and modifying corporate health and safety policy.

Site Personnel – Responsible for understanding and implementing this SOP and the TtNUS Utility Locating and Clearance Policy.

5.0 PROCEDURES

This procedure addresses the requirements and technical procedures that must be performed to minimize the potential for contact with underground and overhead utility services. These procedures are addressed individually from a buried and overhead standpoint.

5.1 Buried Utilities

Buried utilities present a heightened concern because their location is not typically obvious by visual observation, and it is common that their presence and/or location is unknown or incorrectly known on client properties. The following procedure must be followed prior to beginning any excavation that might potentially be in the vicinity of underground utility services. In addition, the Utility Clearance Form (Attachment 3) must be completed for every location or cluster of locations where intrusive activities will occur.

Where the positive identification and de-energizing of underground utilities cannot be obtained and confirmed using the following steps, the PM/TOM is responsible for arranging for the procurement of a qualified, experienced, utility locating subcontractor who will accomplish the utility location and demarcation duties specified herein.

1. A comprehensive review must be made of any available property maps, blue lines, or as-builts prior to site activities. Interviews with local personnel familiar with the area should be performed to provide additional information concerning the location of potential underground utilities. Information regarding utility locations shall be added to project maps upon completion of this exercise.

2., A visual site inspection must be performed to compare the site plan information to actual field conditions. Any findings must be documented and the site plan/maps revised. The area(s) of proposed excavation or other subsurface activities must be marked at the site in white paint or pin flags to identify those locations of the proposed intrusive activities. The site inspection should focus on locating surface indications of potential underground utilities. Items of interest include the presence of nearby area lights, telephone service, drainage grates, fire hydrants, electrical service vaults/panels, asphalt/concrete scares and patches, and topographical depressions. Note the location of any emergency shut off switches. Any additional information regarding utility locations shall be added to project maps upon completion of this exercise and returned to the PM/TOM.

3. If the planned work is to be conducted on private property (e.g., military installations, manufacturing facilities, etc.) the FOL must identify and contact appropriate facility personnel (e.g., public works or facility engineering) before any intrusive work begins to inquire about (and comply with) property owner requirements. It is important to note that private property owners may require several days to several weeks advance notice prior to locating utilities.

4. If the work location is on public property, the state agency that performs utility clearances must be notified (see Attachment 1). State "one-call" services must be notified prior to commencing fieldwork per their requirements. Most one-call services require, by law, 48- to 72-hour advance notice prior to beginning any excavation. Such services typically assign a "ticket" number to the particular site. This ticket number must be recorded for future reference and is valid for a specific period of time, but may be extended by contacting the service again. The utility service will notify utility representatives who then mark their respective lines within the specified time frame. It should be noted that most military installations own their own utilities but may lease service and maintenance from area providers. Given this situation, "one call" systems may still be required to provide location services on military installations.

5. Utilities must be identified and their locations plainly marked using pin flags, spray paint, or other accepted means. The location of all utilities must be noted on a field sketch for future inclusion on project maps. Utility locations are to be identified using the following industry-standard color code scheme, unless the property owner or utility locator service uses a different color code:

white	excavation/subsurface investigation location
red	electrical
yellow	gas, oil, steam
orange	telephone, communications
blue	water, irrigation, slurry
green	sewer, drain

6. Where utility locations are not confirmed with a high degree of confidence through drawings, schematics, location services, etc., the work area must be thoroughly investigated prior to beginning the excavation. In these situations, utilities must be identified using such methods as passive and intrusive surveys, physical probing, or hand augering. Each method has advantages and disadvantages including complexity, applicability, and price. It also should be noted that in many states, initial excavation is required by hand to a specified depth.

7. At each location where trenching or excavating will occur using a backhoe or other heavy equipment, and where utility identifications and locations cannot be confirmed prior to groundbreaking, the soil must be probed with a hand auger or pole (tile probe) made of non-conductive material. If these efforts are not successful in clearing the excavation area of suspect utilities, hand shoveling must be performed for the perimeter of the intended excavation.

8. All utilities uncovered or undermined during excavation must be structurally supported to prevent potential damage. Unless necessary as an emergency corrective measure, TtNUS shall not make any repairs or modifications to existing utility lines without prior permission of the utility owner, property owner, and Corporate HSM. All repairs require that the line be locked-out/tagged-out prior to work.

5.2 Overhead Power Lines

If it is necessary to work within the minimum clearance distance of an overhead power line, the overhead line must be de-energized and grounded, or re-routed by the utility company or a registered electrician. If protective measures such as guarding, isolating, or insulating are provided, these precautions must be adequate to prevent employees from contacting such lines directly with any part of their body or indirectly though conductive materials, tools, or equipment.

The following table provides the required minimum clearances for working in proximity to overhead power lines.

Nominal Voltage	Minimum Clearance
0 -50 kV	10 feet, or one mast length; whichever is greater
50+ kV	10 feet plus 4 inches for every 10 kV over 50 kV or 1.5 mast lengths; whichever is greater

6.0 UNDERGROUND LOCATING TECHNIQUES

6.1 Geophysical Methods

Geophysical methods include electromagnetic induction, magnetics, and ground penetrating radar. Additional details concerning the design and implementation of electromagnetic induction, magnetics, and ground penetrating radar surveys can be found in one or more of the TtNUS SOPs included in the References (Section 8.0).

Electromagnetic Induction

Electromagnetic Induction (EMI) line locators operate either by locating a background signal or by locating a signal introduced into the utility line using a transmitter. A utility line acts like a radio antenna, producing electrons, which can be picked up with a radiofrequency receiver. Electrical current carrying conductors have a 60HZ signal associated with them. This signal occurs in all power lines regardless of voltage. Utilities in close proximity to power lines or used as grounds may also have a 60HZ signal, which can be picked up with an EM receiver. A typical example of this type of geophysical equipment is an EM-61.

EMI locators specifically designed for utility locating use a special signal that is either indirectly induced onto a utility line by placing the transmitter above the line or directly induced using an induction clamp. The clamp induces a signal on the specific utility and is the preferred method of tracing since there is little chance of the resulting signals being interfered with. A good example of this type of equipment is the Schonstedt® MAC-51B locator. The MAC-51B performs inductively traced surveys, simple magnetic locating, and traced nonmetallic surveys.

When access can be gained inside a conduit to be traced, a flexible insulated trace wire can be used. This is very useful for non-metallic conduits but is limited by the availability of gaining access inside the pipe.

Magnetics

Magnetic locators operate by detecting the relative amounts of buried ferrous metal. They are incapable of locating or identifying nonferrous utility lines but can be very useful for locating underground storage tanks (UST's), steel utility lines, and buried electrical lines. A typical example of this type of equipment is the Schonstedt® GA-52Cx locator. The GA-52Cx is capable of locating 4-inch steel pipe up to 8 feet deep.

Non-ferrous lines are often located by using a typical plumbing tool (snake) fed through the line. A signal is then introduced to the snake that is then traced.

Ground Penetrating Radar

Ground Penetrating Radar (GPR) involves specialized radar equipment whereby a signal is sent into the ground via a transmitter. Some portion of the signal will be reflected from the subsurface material, which is then recorded with a receiver and electronically converted into a graphic picture. In general, an object which is harder than the surrounding soil will reflect a stronger signal. Utilities, tunnels, UST's, and footings will reflect a stronger signal than the surrounding soil. Although this surface detection method may determine the location of a utility, this method does not specifically identify utilities (i.e., water vs. gas, electrical vs. telephone); hence, verification may be necessary using other methods. This method is somewhat limited when used in areas with clay soil types or with a high water table.

6.2 Passive Detection Surveys

Acoustic Surveys

Acoustic location methods are generally most applicable to waterlines or gas lines. A highly sensitive Acoustic Receiver listens for background sounds of water flowing (at joints, leaks, etc.) or to sounds introduced into the water main using a transducer. Acoustics may also be applicable to determine the location of plastic gas lines.

Thermal Imaging

Thermal (i.e., infrared) imaging is a passive method for detecting the heat emitted by an object. Electronics in the infrared camera convert subtle heat differentials into a visual image on the viewfinder or a monitor. The operator does not look for an exact temperature; rather they look for heat anomalies (either elevated or suppressed temperatures) characteristic of a potential utility line.

The thermal fingerprint of underground utilities results from differences in temperature between the atmosphere and the fluid present in a pipe or the heat generated by electrical resistance. In addition, infrared scanners may be capable of detecting differences in the compaction, temperature and moisture content of underground utility trenches. High-performance thermal imagery can detect temperature differences to hundredths of a degree.

6.3 Intrusive Detection Surveys

Vacuum Excavation

Vacuum excavation is used to physically expose utility services. The process involves removing the surface material over approximately a 1' x 1' area at the site location. The air-vacuum process proceeds with the simultaneous action of compressed air-jets to loosen soil and vacuum extraction of the resulting debris. This process ensures the integrity of the utility line during the excavation process, as no hammers, blades, or heavy mechanical equipment comes into contact with the utility line, eliminating the risk of damage to utilities. The process continues until the utility is uncovered. Vacuum excavation can be used at the proposed site location to excavate below the "utility window" which is usually 8 feet.

Hand-auger Surveys

When the identification and location of underground utilities cannot be positively confirmed through document reviews and/or other methods, borings must be hand-augered for all locations where there is a potential to impact buried utilities. The minimum hand-auger depth that must be reached is to be determined considering the geographical location of the work site. This approach recognizes that the placement of buried utilities is influenced by frost line depths that vary by geographical region. Attachment 2 presents frost line depths for the regions of the contiguous United States. At a minimum, hand-auger depths must be at least to the frost line depth plus two (2) feet, but never less than 4 feet below ground surface (bgs). For augering, the hole must be reamed by hand to at least the diameter of the drill rig auger or bit prior to drilling. For soil gas surveys, the survey probe shall be placed as close as possible to the cleared hand-auger. It is important to note that a post-hole digger must not be used in place of a hand-auger.

Tile Probe Surveys

For some soil types, site conditions, and excavation requirements, tile probes may be used instead of or in addition to hand-augers. Tile probes must be performed to the same depth requirements as hand-augers. Depending upon the site conditions and intended probe usage, tile probes should be made of non-conductive material such as fiberglass.

7.0 INTRUSIVE ACTIVITIES SUMMARY

The following list summarizes the activities that must be performed prior to beginning subsurface activities:

1. Map and mark all subsurface locations and excavation boundaries using white paint or markers specified by the client or property owner.

2. Notify the property owner and/or client that the locations are marked. At this point, drawings of locations or excavation boundaries shall be provided to the property owner and/or client so they may initiate (if applicable) utility clearance.

   Note: Drawings with confirmed locations should be provided to the property owner and/or client as soon as possible to reduce potential time delays.

3. Notify "One Call" service. If possible, arrange for an appointment to show the One Call representative the subsurface locations or excavation boundaries in person. This will provide a better location designation to the utilities they represent. You should have additional drawings should you need to provide plot plans to the One Call service.

4. Complete Attachment 3, Utility Clearance Form. This form should be completed for each excavation location. In situations where multiple subsurface locations exist within the close proximity of one another, one form may be used for multiple locations provided those locations are noted on the Utility Clearance Form. Upon completion, the Utility Clearance Form and revised/annotated utility location map becomes part of the project file.

8.0 REFERENCES

TtNUS Utility Locating and Clearance Policy
TtNUS SOP GH-3.1; Resistivity and Electromagnetic Induction
TtNUS SOP GH-3.2; Magnetic and Metal Detection Surveys
TtNUS SOP GH-3.4; Ground-penetrating Radar Surveys

ATTACHMENT 1
LISTING OF UNDERGROUND UTILITY CLEARANCE RESOURCES

ALABAMA
Alabama Line Location (800) 292-8525

Tucson Blue Stake Center (800) 782-5348

Alaska
Locate Call Center of Alaska Inc. (800) 478-3121

Arizona
Arizona Blue Stake Inc. (800) 782-5348

Arkansas
Arkansas One Call System Inc. (800) 482-8998

California
Underground Service Alert North (800) 227-2600

Underground Service Alert South (800) 227-2600

Colorado
Utility Notification Center of Colorado
(800) 922-1987

Connecticut
Call Before You Dig (800) 922-4455

Delaware
Miss Utility of Delmarva
(800) 282-8555

District of Columbia
Miss Utility (800) 257-7777

Florida
Call Sunshine (800) 432-4770

Georgia
Utilities Protection Center Inc.
(800) 282-7411

Idaho
Palouse Empire Underground Coordinating Council
(800) 882-1974

Utilities Underground Location Center
(800) 424-5555

Kootenai Country Utility Coordinating Council
(800) 428-4950

Shoshone County One Call (800) 398-3285

Dig Line (800) 342-1585

One Call Concepts (800) 626-4950

Illinois
Julie Inc. (800) 892-0123

Digger (Chicago Utility Alert Network)
(312) 744-7000

Indiana
Indiana Underground Plant Protection Services
(800) 382-5544

Iowa
Underground Plant Location Service Inc.
(800) 292-8989

Kansas
Kansas One-Call Center (800) 344-7233

Kentucky
Kentucky Underground Protection Inc.
(800) 752-6007

Louisiana
Louisiana One Call (800) 272-3020

Maine
Dig Safe – Maine (800) 225-4977

Maryland
Miss Utility (800) 257-777

Miss Utility of Delmarva (800) 282-8555

Massachusetts
Dig Safe – Massachusetts (800) 322-4844

Michigan
Miss Dig System (800) 482-7171

Minnesota
Gopher State One Call (800) 252-1166

Mississippi
Mississippi One-Call System Inc. (800) 227-6477

Missouri
Missouri One Call System Inc. (800) 344-7483

Montana
Utilities Underground Location Center
(800) 424-5555

Montana One Call Center (800) 551-8344

Nebraska
Diggers Hotline of Nebraska (800) 331-5666

Nevada
Underground Service Alert North (800) 227-2600

New Hampshire
Dig Safe – New Hampshire (800) 225-4977

New Jersey
New Jersey One Call (800) 272-1000

New Mexico
New Mexico One Call System Inc.
(800) 321-ALERT

Las Cruces-Dona Utility Council (505) 526-0400

New York
Underground Facilities Protection Organization
(800) 962-7962

New York City: Long Island One Call Center
(800) 272-4480

North Carolina
The North Carolina One-Call Center Inc.
(800) 632-4949

North Dakota
Utilities Underground Location Center
(800) 795-0555

Ohio
Ohio Utilities Protection Service
(800) 362-2764

Oil & Gas Producers Underground Protection Service
(800) 925-0988

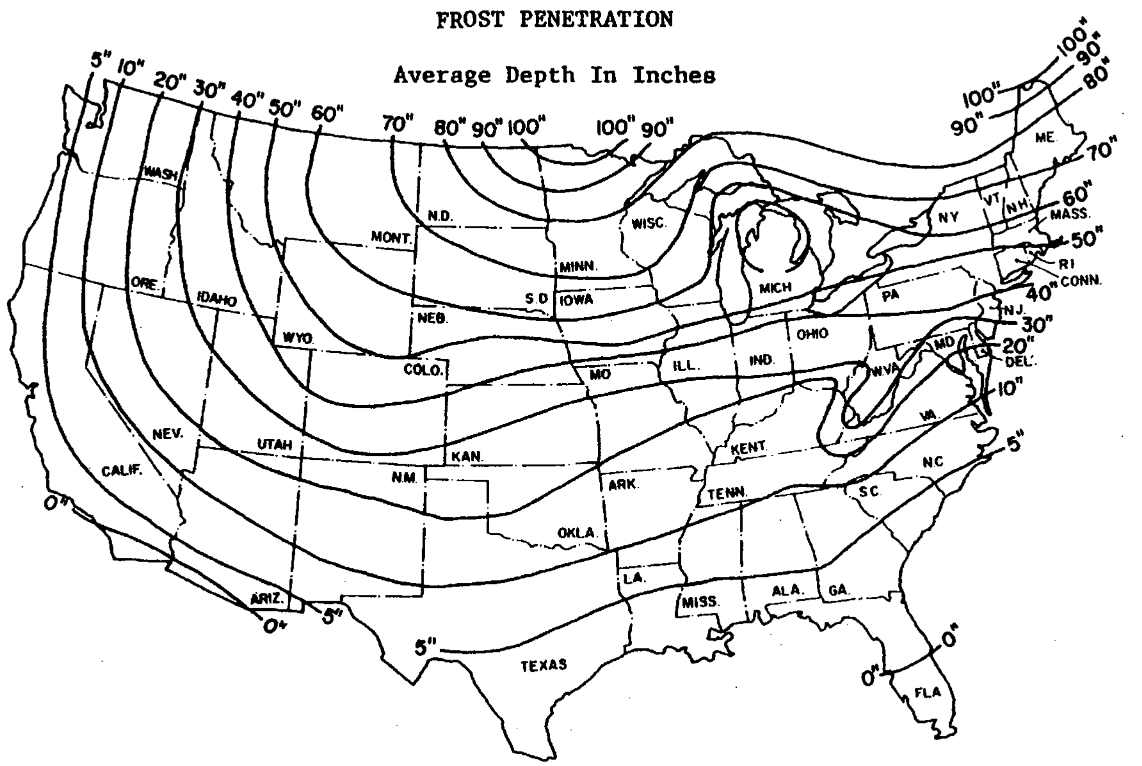
Oklahoma
Call Okie (800) 522-6543

Oregon Utilities Underground Location Center (800) 424-5555 Douglas Utilities Coordinating Council (503) 673-6676 Josephine Utilities Coordinating Council (503) 476-6676 Rogue Basin Utility Coordinating Council (503) 779-6676 Utilities Notification Center (800) 332-2344
Pennsylvania Pennsylvania One Call System Inc. (800) 242-1776
Rhode Island Dig Safe – Rhode Island (800) 225-4977
South Carolina Palmetto Utility Protection Service Inc. (800) 922-0983
South Dakota South Dakota One Call (800) 781-7474
Tennessee Tennessee One-Call System (800) 351-1111
Texas Texas One Call System (800) 245-4545 Texas Excavation Safety System (800) 344-8377 Lone Star Notification Center (800) 669-8344
Utah Blue Stakes Location Center (800) 662-4111
Vermont Dig Safe – Vermont (800) 225-4977
Virginia Miss Utility of Virginia (800) 552-7001 Miss Utility (800) 257-7777 Miss Utility of Delmarva (800) 441-8355
Washington Utilities Underground Location Center (800) 424-5555 Grays Harbor & Pacific County Utility Coordinating Council (206) 535-3550 Utilities County of Cowlitz County (360) 425-2506 Chelan-Douglas Utilities Coordinating Council (509) 663-6111 Upper Yakima County Underground Utilities Council (800) 553-4344 Inland Empire Utility Coordinating Council (509) 456-8000 Palouse Empire Utilities Coordinating Council (800) 822-1974 Utilities Notification Center (800) 332-2344
West Virginia Miss Utility of West Virginia Inc. (800) 245-4848
Wisconsin Diggers Hotline Inc. (800) 242-8511

Wyoming West Park Utility Coordinating Council (307) 587-4800 Call-In Dig-In Safety Council (800) 300-9811 Fremont County Utility Coordinating Council (800) 489-8023 Central Wyoming Utilities Coordinating Council (800) 759-8035 Southwest Wyoming One Call (307) 362-8888 Carbon County Utility Utility Coordinating Council (307) 324-6666 Albany County Utility Coordinating Council (307) 742-3615 Southeast Wyoming Utilities Coordinating Council (307) 638-6666 Wyoming One-Call (800) 348-1030 Utilities Underground Location Center (800) 454-5555 Converse County Utility Coordination Council (800) 562-5561

ATTACHMENT 2

FROST LINE PENETRATION DEPTHS BY GEOGRAPHIC LOCATION



Courtesy U.S. Department Of Commerce

ATTACHMENT 3
UTILITY CLEARANCE FORM

Client: ____________________ Project Name: ______________________________

Project No.: ______________________ Completed By: ______________________________

Location Name: __________________________ Work Date: ____________________________

Excavation Method/Overhead Equipment: ____

			Circle One
1.	Underground Utilities		
	a)	Review of existing maps?	yes no N/A
	b)	Interview local personnel?	yes no N/A
	c)	Site visit and inspection?	yes no N/A
	d)	Excavation areas marked in the field?	yes no N/A
	e)	Utilities located in the field?	yes no N/A
	f)	Located utilities marked/added to site maps?	yes no N/A
	g)	Client contact notified Name ______________ Telephone: ___________ Date: ______________	yes no N/A
	g)	State One-Call agency called? Caller: ________________________________ Ticket Number: ___________________________ Date: ______________	yes no N/A
	h)	Geophysical survey performed? Survey performed by: ____________________ Method: ________________________________ Date: ______________	yes no N/A
	i)	Hand augering performed? Augering completed by: ____________________ Total depth: __________ feet Date: _______	yes no N/A
	j)	Trench/excavation probed? Probing completed by: ____________________ Depth/frequency: __________________________ Date: ______________	yes no N/A
2.	Overhead Utilities		Present Absent
	a)	Determination of nominal voltage	yes no N/A
	b)	Marked on site maps	yes no N/A
	c)	Necessary to lockout/insulate/re-route	yes no N/A
	d)	Document procedures used to lockout/insulate/re-route	yes no N/A
	e)	Minimum acceptable clearance (SOP Section 5.2): __________________	

3. Notes:

____

____

____

Approval:

_____________________________________ ____________________

Site Manager/Field Operations Leader Date

c: PM/Project File
Program File

ATTACHMENT III

EQUIPMENT INSPECTION
AND
LOAD INSPECTION CHECKLISTS

EQUIPMENT INSPECTION CHECKLISTS

EQUIPMENT INSPECTION FOR DRILL RIGS

COMPANY:____ **UNIT NO.**___________________

FREQUENCY: Inspect at the initiation of the project, after repairs, once every 10-day shift.

Inspection Date: ____/____/_____ Time: _______ Equipment Type:__________________________

(e.g., **Drill Rigs** Hollow Stem, Mud Rotary, Direct Push)

	Good	Need Repair	N/A
Emergency Stop Devices (At points of operation)	❒	❒	❒
Tires (Tread) or tracks	❒	❒	❒
Hoses and belts	❒	❒	❒
Cab, mirrors, safety glass	❒	❒	❒
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	❒	❒	❒
- Is the equipment equipped with audible back-up alarms and back-up lights?	❒	❒	❒
Horn and gauges	❒	❒	❒
Brake condition (dynamic, park, etc.)	❒	❒	❒
Fire extinguisher (Type/Rating -____________)	❒	❒	❒
Fluid Levels:			
- Engine oil	❒	❒	❒
- Transmission fluid	❒	❒	❒
- Brake fluid	❒	❒	❒
- Cooling system fluid	❒	❒	❒
- Windshield wipers	❒	❒	❒
- Hydraulic oil	❒	❒	❒
Oil leak/lube	❒	❒	❒
Coupling devices and connectors	❒	❒	❒
Exhaust system	❒	❒	❒
Mast condition (Mast Height________)	❒	❒	❒
Access-ways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	❒	❒	❒
Steering (standard and emergency)	❒	❒	❒
Power cable and/or hoist cable	❒	❒	❒
➢ Hooks			
- Safety Latch	❒	❒	❒
- Wear in excess of 10% original dimension	❒	❒	❒
- A bend or twist exceeding 10% from the plane of an unbent hook	❒	❒	❒
- Increase in throat opening exceeding 15% from new condition	❒	❒	❒
- Excessive nicks and/or gouges	❒	❒	❒
➢ Wire Rope (Hoist Mechanism)			
- Reduction in Rope diameter (5/16 wire rope>1/64 reduction nominal size -replace) (3/8 to 1/2 wire rope>1/32 reduction nominal size-replace) (9/16 to 3/4 wire rope>3/64 reduction nominal size-replace)	❒	❒	❒
- Number of broken wires (12 randomly broken wires in one rope lay) (4 broken wires in one strand)	❒	❒	❒
- Number of wire rope wraps left on the Running Drum at nominal use ($\geq$3 required)	❒	❒	❒
- Lead (primary) sheave is centered on the running drum	❒	❒	❒
- Lubrication of wire rope (adequate?)	❒	❒	❒

	Good	Needs Repaired	N/A
- Number of U-Type (Crosby) Clips (5/16 – 5/8 = 3 clips minimum) (3/4 – 1 inch = 4 clips minimum) (1 1/8 – 1 3/8 inch = 5 clips minimum)	❒	❒	❒
➢ Kinks, bends – Flattened to > 50% diameter	❒	❒	❒
➢ Hemp/Fiber rope (Cathead/Split Spoon Hammer)			
- Minimum ¾;maximum 1inch rope diameter (Inspect for physical damage)	❒	❒	❒
- Rope to hammer is securely fastened	❒	❒	❒

Safety Guards:

	Yes	No
Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?____________________	❒	❒
Hot pipes and surfaces exposed to accidental contact?____________________	❒	❒
All emergency shut offs have been identified and communicated to the field crew?__________	❒	❒
Are any structural members bent, rusted, or otherwise show signs of damage?__________	❒	❒
Are fueling cans used with this equipment approved type safety cans?__________	❒	❒
Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?____________________	❒	❒

Cleanliness:

Overall condition (was the decontamination performed prior to arrival on-site considered acceptable)?__________

Where was this equipment used prior to its arrival on site?____________________
Site Contaminants of concern at the previous site?____________________
Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?__________
Flammable solvents stored in the operators cab?____________________

Operator Qualifications (as applicable for all heavy equipment):

Does the operator have proper licensing where applicable, (e.g., CDL)?____________________
Does the operator, understand the equipment's operating instructions?____________________
Is the operator experienced with this equipment? ____________________
Is the operator 21 years of age or more?____________________

ADDITIONAL INSPECTION REQUIRED PRIOR TO USE ON-SITE

	Yes	No
Does equipment emit noise levels above 90 decibels?	❒	❒
If so, has an 8-hour noise dosimetry test been performed?	❒	❒

Results of noise dosimetry:____________________
Defects and repairs needed:____________________
General Safety Condition: ____________________
Operator or mechanic signature:____________________

Site Safety Officer Signature:____________________

Approved for Use: ❒ Yes ❒ No

EQUIPMENT INSPECTION (Heavy Equipment)

COMPANY:____ **UNIT NO.**__________________

FREQUENCY: Inspect at the initiation of the project, after repairs, once every 10-day shift.

Inspection Date: ____/____/____ Time: _______ Equipment Type:_________________________
(e.g., bulldozer, generator)

	Good	Need Repair	N/A
Tires or tracks	☐	☐	☐
Hoses and belts	☐	☐	☐
Cab, mirrors, safety glass	☐	☐	☐
- Turn signals, lights, brake lights, etc. (front/rear) for equipment approved for highway use?	☐	☐	☐
- Is the equipment equipped with audible back-up alarms and back-up lights?	☐	☐	☐
Horn and gauges	☐	☐	☐
Brake condition (dynamic, park, etc.)	☐	☐	☐
Fire extinguisher (Type/Rating -___________)	☐	☐	☐
Fluid Levels:			
- Engine oil	☐	☐	☐
- Transmission fluid	☐	☐	☐
- Brake fluid	☐	☐	☐
- Cooling system fluid	☐	☐	☐
- Windshield wipers	☐	☐	☐
- Hydraulic oil	☐	☐	☐
Oil leak/lube	☐	☐	☐
Coupling devices and connectors	☐	☐	☐
Exhaust system	☐	☐	☐
Blade/boom/ripper condition	☐	☐	☐
Access-ways: Frame, hand holds, ladders, walkways (non-slip surfaces), guardrails?	☐	☐	☐
Power cable and/or hoist cable	☐	☐	☐
Steering (standard and emergency)	☐	☐	☐

Safety Guards:	**Yes**	**No**
– Around rotating apparatus (belts, pulleys, sprockets, spindles, drums, flywheels, chains) all points of operations protected from accidental contact?_______________________________________	☐	☐
– Hot pipes and surfaces exposed to accidental contact?_______________________________	☐	☐
– All emergency shut offs have been identified and communicated to the field crew?____________	☐	☐
– Have emergency shutoffs been field tested? ______________________________________	☐	☐
– Results?____	☐	☐
– Are any structural members bent, rusted, or otherwise show signs of damage?______________	☐	☐
– Are fueling cans used with this equipment approved type safety cans?__________________	☐	☐

- Have the attachments designed for use (as per manufacturer's recommendation) with this equipment been inspected and are considered suitable for use?____________________________ ❐ ❐
  ____

Cleanliness:

- Overall condition (was the decontamination performed prior to arrival on-site considered acceptable)?____________
  ____
- Where was this equipment used prior to its arrival on site?____
- Site Contaminants of concern at the previous site?____
- Inside debris (coffee cups, soda cans, tools and equipment) blocking free access to foot controls?______________

Operator Qualifications (as applicable for all heavy equipment):

- Does the operator have proper licensing where applicable, (e.g., CDL)?________________________________
- Does the operator, understand the equipment's operating instructions?________________________________
- Is the operator experienced with this equipment? ____
- Does the operator have emotional and/or physical limitations which would prevent him/her from performing this task in a safe manner?____
- Is the operator 21 years of age or more?____

Identification:

- Is a tagging system available, for positive identification, for tools removed from service?___

Additional Inspection Required Prior to Use On-Site

	Yes	No
– Does equipment emit noise levels above 90 decibels?	❐	❐
– If so, has an 8-hour noise dosimetry test been performed?	❐	❐

- Results of noise dosimetry:____
- Defects and repairs needed:____
- General Safety Condition: ____
- Operator or mechanic signature:____

Site Safety Officer Signature:____

Approved for Use: ❐ Yes ❐ No

LOAD INSPECTION CHECKLIST FOR
SOIL REMOVAL AT NCBC GULFPORT, GULFPORT MISSISSIPPI

Waste Stream: __________ Facility Disposal No.: __________ Cum Load No.: __________
(by waste stream)

Trucking Company: ______________________ Date: __________

Truck No.: ______________________ Permit No.: __________

License Plate No.: ______________________ Permit No.: __________

Is truck certified to transport hazardous waste in Mississippi? __________

Drivers Name (Print): __________

Drivers Signature: __________

Mississippi CDL Driver Certificate No.: __________

Driver Physically fit to Drive? __________

Driver has documentation of H&S Training (DOT HM-181): __________ CDL Designations: __________

Is the drivers log book current?: __________

Is a valid certificate of insurance in force?: __________

Manifest No.: ______________________ Bill of Lading No.: __________

Manifest complete and accurate?: __________

Are proper DOT approved shipping containers being used? __________

Is labeling in accordance with 40 CFR?: __________

Overall condition of trailer of shipping containers: __________

Is Truck properly lined (plastic) and tarped? __________

Is Tailgate Seal in good condition? __________ Tailgate turn buckles being used?: __________

Is trailer or containers leaking?: __________

Inspector Name: __________

Inspector Signature: __________

Additional comments: Wet excavated soils average 2900-3000 lbs/cubic yard. This figure should be employed when estimating weight of loaded truck.

ATTACHMENT IV

SAFE WORK PERMITS

SAFE WORK PERMIT
DECONTAMINATION ACTIVITIES
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ________ Date: ________ Time: From ________ to ________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Decontamination of heavy equipment and machinery (i.e., drill rigs, augers) will be performed using pressure washers or steam cleaning units. Brushes and spray bottles will be used to decon small sampling equipment.

II. Required Monitoring Instrument(s): None

III. Field Crew: ________

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector ________ ________
TtNUS

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: When using pressure washers, steam cleaners field crews will wear hearing protection, and face shields.

V.

Chemicals of Concern	Action Level(s)	Response Measures
TCDD	>2 mg/m^3	Dust Suppression/Area Wetting
Decontamination Solvent		Per MSDS

VI. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes ☐ No	Hearing Protection (Plugs/Muffs)	☐ Yes ☐ No
Safety Glasses	☒ Yes ☐ No	Safety belt/harness	☐ Yes ☒ No
Chemical/splash goggles	☐ Yes ☒ No	Radio	☐ Yes ☒ No
Splash Shield	☒ Yes ☐ No	Barricades	☐ Yes ☒ No
Splash suits/coveralls	☒ Yes ☐ No	Gloves (Type - Nitrile)	☒ Yes ☐ No
Steel toe Work shoes or boots	☒ Yes ☐ No	Work/rest regimen	☐ Yes ☒ No
Chemical Resistant Boot Covers	☒ Yes ☐ No	Impermeable apron	☒ Yes ☐ No

Modifications/Exceptions: PVC rain suits or PE or PVC coated Tyvek or impermeable aprons are acceptable when cleaning sampling equipment instead of a splash suit for protection against splashes and overspray. Chemical resistant boot covers if excessive liquids are generated or to protected footwear within the decontamination containment pad. Hearing protection is required when operating the steam cleaner or pressure washer.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☒
Emergency Equipment Staged	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.). ☐ Yes ☒ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Chemical hazards are associated with decontamination activity because of use of fluids such as isopropyl alcohol, etc. To minimize the potential for exposure, site personnel will use PPE and prevent contact with potentially contaminated equipment and identified solvents. Refer to the manufacturer's MSDS regarding PPE, handling, storage, and first-aid measures related to decontamination fluids. For pressure washers or steam cleaners in excess of 3,000 psi a fan tip of 25° or greater will be used to control potential for water cuts or lacerations. Do not point at other personnel even in fu. All hoses and fittings will be inspected to insure structural integrity prior to use. Decontamination Pad construction – sloped a sufficient degree to allow collection at a sump away from the work area; the temporary pad constructed of 10-30 mil polyethylene sheeting should be covered in a light coating of sand if the surface becomes to slippery.

Permit Issued by: ________ Permit Accepted by: ________

SAFE WORK PERMIT
MOBILIZATION / DEMOBILIZATION
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ______________ Date: __________________ Time: From ____________ to ______________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Mobilization and demobilization activities.

II. Required Monitoring Instruments: None

III. Field Crew: ____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector ____________ TtNUS ____________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required
Full face APR ☐
Half face APR ☐
SKA-PAC SAR ☐
Skid Rig ☐
Escape Pack ☐
SCBA ☐
Bottle Trailer ☐
None ☒

Modifications/Exceptions: ____

V. Chemicals of Concern / Action Level(s) / Response Measures

Chemicals of Concern	Action Level(s)	Response Measures
None anticipated		

VI. Additional Safety Equipment/Procedures

	Yes	No		Yes	No
Hard-hat	☐	☐	Hearing Protection (Plugs/Muffs)	☐	☐
Safety Glasses	☒	☐	Safety belt/harness	☐	☒
Chemical/splash goggles	☐	☒	Radio	☐	☒
Splash Shield	☐	☒	Barricades	☐	☒
Splash suits/coveralls	☐	☒	Gloves (Type -)	☐	☒
Steel toe Work shoes or boots	☒	☐	Work/rest regimen	☐	☒

Modifications/Exceptions: Pant legs taped to work boots if in an area of heavy vegetation. Tyvek coverall may also be used to protect against natural hazards (e.g., ticks). Use repellents as protection against insects. If working in areas where snakes are a threat, wear snake chap s to protect against bites. Area which are frequented by alligators should also take the necessary precautions listed in Section 6.3 of this HASP. Hard hats will be worn if potential for overhead or bump hazards exist. Safety glasses will be worn if the potential for flying projectiles exist. This logic will apply to the use of hearing protection and gloves as applicable.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☒	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☒	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☒ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Avoid potential nesting areas. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Inspect clothing and body for ticks. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task.

Permit Issued by:______________________________ Permit Accepted by:______________________

SAFE WORK PERMIT
MULTI-MEDIA SAMPLING
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ______________ Date: __________________ Time: From ____________ to ____________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Multi media sampling including soils (surface and sub surface); sediments; groundwater and IDW.

II. Required Monitoring Instrument(s): None

III. Field Crew: ______________________________

IV. On-site Inspection conducted ☒ Yes ☐ No Initials of Inspector ____________ TtNUS ____________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SKA-PAC SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirement are stated below.

V.

Chemicals of Concern	Action Level(s)	Response Measures
TCDD	>2 mg/m^3 (Visible dust)	Dust Suppression/Area Wetting

VI. Additional Safety Equipment/Procedures

Hard-hat	☐ Yes ☐ No		Hearing Protection (Plugs/Muffs)	☐ Yes ☐ No	
Safety Glasses	☒ Yes ☐ No		Safety belt/harness	☐ Yes ☒ No	
Chemical/splash goggles	☐ Yes ☒ No		Radio	☐ Yes ☐ No	
Splash Shield	☐ Yes ☒ No		Barricades	☐ Yes ☒ No	
Splash suits/coveralls	☐ Yes ☐ No		Gloves (Type - Nitrile)	☒ Yes ☐ No	
Steel toe Work shoes or boots	☒ Yes ☐ No		Work/rest regimen	☐ Yes ☒ No	
Chemical Resistant Boot Covers	☒ Yes ☐ No		Impermeable apron	☒ Yes ☐ No	

Modifications/Exceptions: Tyvek coverall if there is a potential for soiling work clothes and PVC or PE coated Tyvek if saturation or work clothes may occur. Impermeable aprons may be used in lieu of the coveralls if it can be demonstrated that it offers as much protection as the coveralls. This modification may be made to support measures against effects of heat stress. Reflective vests for high traffic areas.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.) ☐ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Avoid potential nesting areas. Tape pant legs and use insect repellents in forested and heavily vegetated areas. Snake chaps or leggings should be worn in areas prone to snakes. The FOL and/or the SSO shall preview work areas for signs of habitation, nesting, or foraging in remote areas where sampling is to be conducted. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Inspect clothing and body for ticks upon exiting wooded areas and high brush. Personal decontamination for this task shall include efforts at remote locations such as bagging contaminated PPE and reusable sampling tools and using hygienic wipes for hands and face until persons can reach the structured decontamination unit. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for mobilization/demobilization.

Permit Issued by: ______________________ Permit Accepted by: ______________________

SAFE WORK PERMIT
SOIL BORING AND SUBSURFACE SOIL SAMPLING OPERATIONS
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ____________ Date: ______________ Time: From __________ to ___________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Subsurface soil sample collected via hollow stem auger.

II. Required Monitoring Instruments: None , as necessary (See Table 5-1)

III. Field Crew: ______________________________

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector __________ TtNUS __________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required

Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required

Full face APR	☐	Escape Pack	☐
Half face APR	☐	SCBA	☐
SAR	☐	Bottle Trailer	☐
Skid Rig	☐	None	☒

Modifications/Exceptions: Minimum requirements stated below.

V. Chemicals of Concern	Action Level(s)	Response Measures
TCDD	>2 mg/m^3 (visible dust)	Dust Suppression/Area Wetting

VI. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No	Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No	Safety belt/harness	☐ Yes	☒ No
Chemical/splash goggles	☐ Yes	☒ No	Radio	☐ Yes	☐ No
Splash Shield	☐ Yes	☒ No	Barricades	☐ Yes	☐ No
Splash suits/coveralls	☐ Yes	☒ No	Gloves (Type - Nitrile)	☒ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No	Work/rest regimen	☐ Yes	☒ No
Chemical Resistant Boot Covers	☒ Yes	☐ No	Impermeable apron	☒ Yes	☐ No

Modifications/Exceptions: Reflective vests for high traffic areas. Tyvek coverall if there is a potential for soiling work clothes. PVC or PE coated Tyvek, if saturation or work clothes may occur. It is recommended that the Driller and the Driller's helper wear impermeable aprons to prevent soiling of work clothes when handling auger flights against the body. This measure can be used in place of the Tyvek or PE or PVC coated Tyvek if heat stress is an issue. Safety harnesses will be employed for activities greater than 6 feet above ground surface without support of safety handrail.

VII. Procedure review with permit acceptors

	Yes	NA		Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐	Emergency alarms	☒	☐
Procedure for safe job completion	☐	☐	Evacuation routes	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐	Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Staged	☐	☐	☐

IX. Additional Permits required (Utility Locating and Excavation Clearance – Attachment II). .... ☒ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Follow the safe work practices for drilling specified in Section 5.2 of this HASP. Use proper lifting techniques defined in Table 5-1 for mobilization/demobilization. Complete an Equipment Inspection Checklist for the Drill Rig upon arrival to the site, and then every 10 day shift thereafter or after major repairs. Test all emergency stop devices initially then periodically to insure operational status. Decontamination of equipment will consist of soap and water wash and rinse with the use of a pressure washer until visibly clean. Personnel decontamination may also consist of vacuuming outer garments and soap and water wash and rinse of outer PPE and hands and face prior to breaks or meals. As the material in question is a solid potential for exposure can occur only through mechanical dispersion (inhalation) or hand to mouth contact (ingestion) through poor work hygiene practices. For activities in forested or heavily vegetated areas tape pant legs and use insect repellent.

Permit Issued by: ______________________ Permit Accepted by: ______________________

SAFE WORK PERMIT
EXCAVATION OPERATIONS
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ______________ Date: ____________________ Time: From ____________ to ____________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Excavation of soils from on and off-site will occur utilizing earth moving equipment (i.e., track-hoes, back-hoes, skid loaders, high-lifts, etc.). It is estimated that 20 cubic yards of soil will be collected from along Canal Road and moved to Site 8A on NCBC Gulfport

II. Required Monitoring Instruments: None

III. Field Crew: ____________________

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector ____________ TtNUS ____________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
- Level D ☒ Level B ☐
- Level C ☐ Level A ☐
- Detailed on Reverse

Respiratory equipment required
- Full face APR ☐ Escape Pack ☐
- Half face APR ☐ SCBA ☐
- SAR ☐ Bottle Trailer ☐
- Skid Rig ☐ None ☒

Modifications/Exceptions: Upgrade to Level C protection - full-face APR with organic vapor/HEPA cartridges if dust suppression is unsuccessful. This is not anticipated given the concentration of the contaminant in the soils.

V. Chemicals of Concern	Action Level(s)	Response Measures
TCDD	>2 mg/m^3 (visible dust)	Dust Suppression/Area Wetting

VI. Additional Safety Equipment/Procedures

Hard-hat	☒ Yes	☐ No
Safety Glasses	☒ Yes	☐ No
Chemical/splash goggles	☐ Yes	☒ No
Splash Shield	☐ Yes	☒ No
Splash suits/coveralls	☐ Yes	☐ No
Steel toe Work shoes or boots	☒ Yes	☐ No
Chemical Resistant Boot Covers	☐ Yes	☐ No
Hearing Protection (Plugs/Muffs)	☒ Yes	☐ No
Safety belt/harness(Seat Belts)	☒ Yes	☐ No
Radio	☐ Yes	☐ No
Barricades (traffic control)	☒ Yes	☐ No
Gloves (Type - Nitrile)	☒ Yes	☐ No
Work/rest regimen	☐ Yes	☒ No

Modifications/Exceptions: Reflective vests for high traffic areas (Ground Spotters or operators who will leave their cab). All operators and truck drivers will employ seat belts when operating designated equipment

VII. Procedure review with permit acceptors

	Yes	NA
Safety shower/eyewash (Location & Use)	☐	☐
Procedure for safe job completion	☐	☐
Contractor tools/equipment/PPE inspected	☐	☐
Emergency alarms	☒	☐
Evacuation routes	☐	☐
Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed	☐	☐	☐
Vehicle and Foot Traffic Routes Cleared and Established	☐	☐	☐
Physical Hazards Barricaded and Isolated	☐	☐	☐
Emergency Equipment Inspected and Staged (Fire Extinguishers, etc.)	☐	☐	☐

IX. Additional Permits required (Utility Locating and Excavation Clearance – Attachment II). .... ☒ Yes ☐ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Follow the safe work practices for excavation specified in Section 5.0 and Table 5-1 of this HASP. Use proper lifting techniques defined in Table 5-1 for mobilization/demobilization. Complete an Equipment Inspection Checklist for the heavy equipment used in the excavation upon arrival to the site, and then every 10 day shift thereafter or after major repairs. The Ground Spotter will exercise complete control over the area in which the excavation activities are being conducted. No one will enter those areas without the expressed permission of the ground spotter. Traffic patterns will be constructed to facilitate one-way travel to minimize backing where possible. Decontamination will include washing face and hands prior to breaks and or lunch. A Load Inspection Report will be completed for each truck loaded for transport across the base or over public thoroughfares when exiting established exclusion zone(s). See Section 6.2.4 for traffic control specifications. Tape pant legs and use insect repellents in forested and heavily vegetated areas.

Permit Issued by:______________________ Permit Accepted by:______________________

SAFE WORK PERMIT
REMOVAL OF VEGETATION
NCBC GULFPORT, GULFPORT, MISSISSIPPI

Permit No. ______________ Date: __________________ Time: From ____________ to _____________

SECTION I: General Job Scope

I. Work limited to the following (description, area, equipment used): Clearing of vegetation (shrubs, pine trees, etc.). It is anticipated that this will be done using heavy equipment but some hand tool / chainsaw usage is expected to be necessary to initially clear or cut larger diameter trees.

II. Required Monitoring Instruments: None

III. Field Crew: ____

IV. On-site Inspection conducted ☐ Yes ☐ No Initials of Inspector ____________ TtNUS ____________

SECTION II: General Safety Requirements (To be filled in by permit issuer)

IV. Protective equipment required
Level D ☒ Level B ☐
Level C ☐ Level A ☐
Detailed on Reverse

Respiratory equipment required
Full face APR ☐
Half face APR ☐
SKA-PAC SAR ☐
Skid Rig ☐
Escape Pack ☐
SCBA ☐
Bottle Trailer ☐
None ☒

Modifications/Exceptions: ______________________________

V. Chemicals of Concern / Action Level(s) / Response Measures

Chemicals of Concern	Action Level(s)	Response Measures
None anticipated		

VI. Additional Safety Equipment/Procedures

Hard-hat .... ☒ Yes ☐ No
Safety Glasses .... ☒ Yes ☐ No
Chemical/splash goggles .... ☐ Yes ☒ No
Splash Shield .... ☐ Yes ☒ No
Splash suits/coveralls................. ☐ Yes ☒ No
Steel toe Work shoes or boots.... ☒ Yes ☐ No
Hearing Protection (Plugs/Muffs).. ☒ Yes ☐ No
Safety belt/harness......................... ☐ Yes ☒ No
Radio .... ☐ Yes ☒ No
Barricades..................................... ☐ Yes ☒ No
Gloves (Type - Leather)................. ☒ Yes ☐ No
Work/rest regimen .... ☐ Yes ☒ No

Modifications/Exceptions: Pant legs taped to work boots if in an area of heavy vegetation, use insect repellent. Tyvek coverall may also be used to protect against natural hazards (e.g., ticks). If working in areas where snakes are a threat, wear snake chaps to protect against bites. Area which are frequented by alligators should also take the necessary precautions listed in Section 6.3.2.2 of this HASP

VII. Procedure review with permit acceptors

	Yes	NA
Safety shower/eyewash (Location & Use)..........	☐	☒
Procedure for safe job completion......................	☐	☒
Contractor tools/equipment/PPE inspected........	☐	☐
Emergency alarms...................	☒	☐
Evacuation routes....................	☐	☐
Assembly points	☐	☐

VIII. Site Preparation

	Yes	No	NA
Utility Locating and Excavation Clearance completed..........	☐	☐	☒
Vehicle and Foot Traffic Routes Cleared and Established..........	☐	☐	☐
Physical Hazards Barricaded and Isolated..........	☐	☐	☐
Emergency Equipment Staged..........	☐	☐	☐

IX. Additional Permits required (Hot work, confined space entry, excavation etc.)...................... ☐ Yes ☒ No
If yes, complete permit required or contact Health Sciences, Pittsburgh Office

X. Special instructions, precautions: Preview work locations to identify potential hazards (slips, trips, and falls, natural hazards, etc.) Avoid potential nesting areas. Wear light colored clothing so that ticks and other biting insects can be easily visible and can be removed. Inspect clothing and body for ticks. Minimize contact with potentially contaminated media. Suspend site activities in the event of inclement weather. Employ proper lifting techniques as described on Table 5-1 for this task. Maintain two-way visual contact with equipment operators. Ground persons should maintain adequate distance when trees are being cut down.

Permit Issued by: ______________________ Permit Accepted by: ______________________

ATTACHMENT V

MEDICAL DATA SHEET

MEDICAL DATA SHEET

This Medical Data Sheet must be completed by all on-site personnel and kept in a central location during the execution of site operations. This data sheet will accompany any personnel when medical assistance is needed or if transport to hospital facilities is required.

Project ______________________________

Name ______________________ Home Telephone ____________

Address ______________________________

Age __________ Height ______________ Weight ____________

Name of Next Kin ______________________________

Drug or other Allergies ______________________________

Particular Sensitivities ______________________________

Do You Wear Contacts? ______________________________

Provide a Checklist of Previous Illnesses or Exposure to Hazardous Chemicals ____________

____

____

What medications are you presently using? ______________________________

____

____

Do you have any medical restrictions? ______________________________

____

____

Name, Address, and Phone Number of personal physician: ____________________

____

____

I am the individual described above. I have read and understand this HASP.

______________________________ ____________________

Signature Date

ATTACHMENT VI

HEARING CONSERVATION PROGRAM

HEARING CONSERVATION PROGRAM

1.0 PROGRAM OBJECTIVE

To protect Tetra Tech NUS and Subcontractor employees from the harmful effects of exposure to excessive noise levels. Excessive noise in this case will be considered employee noise exposures at or above an 8-hour Time Weighted Average (TWA) of 85 decibels measured on the A-Weighted scale.

This objective will be accomplished through

- Establishing administrative and site-specific hearing conservation procedures and guidelines for employees.
- Audiometric testing of affected employees.
- Site specific monitoring of representative job classifications and operations to determine noise levels and appropriate protective measures.
- Establishment of procedures and guidelines for the selection care and use of hearing protection.
- Warning signs and information.
- Training.

This Hearing Conservation Program (HCP) is divided into two sections. The first section presents the responsibilities of individuals associated with this program and a description of the program's key elements. The second section provides a fill-in the blank tool that is to be used to implement a site-specific HCP on projects where noise exposure is a concern. This second section is presented in Attachment A and must be completed by the Site Safety Officer (SSO) or the Field Operations Leader (FOL) on projects where noise exposure is a recognized potential hazard. The completed fill-in the blank portion, administrative guidelines, and a copy of 29 CFR 1910.95 must be on-site and available to site personnel to ensure regulatory compliance.

2.0 SCOPE

This program applies to all Tetra Tech NUS operations and other support activities where exposure above specified action levels may occur. This program has been developed to comply with OSHA General Industry Standard 29 CFR 1910.95 (Occupational Noise Exposure, retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html).

3.0 RESPONSIBILITIES

Corporate Health and Safety Manager (HSM): Serve as HCP Administrator and provide technical management and oversight of this program, as well as technical support to aid all Tetra Tech NUS office locations in effectively implementing these requirements. The HSM is also responsible for monitoring the overall effectiveness of this program. This will be accomplished by:

- Periodically reviewing random completed Sound Level Measurement and/or Noise Dosimetry Logs.
- Performing field audits of select project sites where the HCP elements are implemented.
- Eliciting feedback from office health and safety Points of Contact.
- Modifying elements of this program, when or as appropriate.
- Establishing minimum components and content of the HCP training course material.
- Maintaining appropriate record-keeping for this program.
- Regularly communicating with Tetra Tech, Inc. Corporate Health and Safety, to satisfy overall company requirements.

Project Health and Safety Officer (PHSO) - The PHSO shall ensure that hearing conservation measures are adequately addressed in the Site Specific Health and Safety Plan for assigned projects. In addition, it is the PHSO's responsibility to provide technical assistance to the Site Safety Officer and/or the Field Operations Leader.

Site Safety Officer (SSO) - The SSO will serve as the Site HCP Administrator and is responsible for the implementation of this HCP at project specific locations. This activity may also include on-site evaluations of noise levels. The SSO shall be responsible for the enforcement of the elements of this program to prevent excessive exposure to high levels of noise.

Field Operations Leader (FOL) – The FOL will share responsibility with the SSO or in the absence of an SSO ensure the implementation of this program for all operations conducted under their direction employing hearing protection.

Project Manager (PM)/Task Order Manager(TOM) - The PM/TOM is also ultimately responsible for the effective compliance with these requirements. The PM/TOM will ensure that sufficient information has been provided to the PHSO to develop a site-specific HCP appropriate for the nature of the planned activities. This is to be accomplished in conjunction with the preparation of the site-specific Health and Safety Plan (HASP).

Tetra Tech NUS Employees - The employees are responsible for following the tenets of this hearing conservation program and/or conditions or modifications of this program, that may be site-specific in nature.

In addition the employees are responsible for reporting any deficiencies or inadequacies of these program or site-specific elements to the SSO and/or the FOL.

4.0 NOISE LEVEL MONITORING

Noise level monitoring will be accomplished using quantitative and qualitative principles to determine potential high noise areas. Quantitative monitoring will be accomplished using portable sound level survey meters and noise dosimeters. The monitoring results will be used for the following purposes:

- Identifying and defining high operational noise areas and high noise job classifications.
- Identification of personnel for inclusion into the Site-Specific HCP.
- Determining employee exposure to noise.

In addition, qualitative monitoring of work areas may be employed by the FOL and/or SSO or field personnel to determine approximate noise level conditions and the need for hearing protection. This involves observing a common simple rule of thumb. This rule of thumb is that, if you must raise your voice to be heard by someone who is standing within arm's length of you to be heard, then noise levels are likely to exceed 85 dBA. Therefore, hearing protection would be required. This rule of thumb may be used for short duration or intermittent activities, or for activities which have been previously quantified.

Quantitative monitoring may be performed for longer-term projects or for tasks that have not been previously characterized. This will be performed using a sound level meter (SLM), noise dosimeters, or both.

Representative data may be used when appropriate from one project to the next to preclude the necessity to monitor similar tasks and activities .

4.1.1 Noise Level Monitoring Data Accumulation and Record-keeping

The Sound Level Measurement Log and the Noise Dosimetry Log provided in Attachment A will be completed to document quantitative measurements recorded on-site. Upon completion copies of these documents will be

1. Attached to their applicable Safe Work Permits
2. Forwarded to the PHSO for review

Direction for the completion of these documents will be provided through the site-specific HASP. If information is not requested it may be assumed that quantitative measurements for the operations in question are not necessary, or that representative data already exists.

4.1.2 Noise Monitoring Frequency

Depending on the nature of planned operations, the SSO and/or the FOL, may be tasked to perform an initial noise survey on Tetra Tech NUS and subcontractors operations and work areas by the use of a sound level meter and/or noise dosimeters.

Repeat noise monitoring will be conducted should operations, productions, or processes change which could impact noise levels that are generated.

4.2 Health and Safety Plan (HASP)

The HASP will set policy on mandatory use of hearing protection in affected areas, and while performing certain operations such as drilling, excavation, operation of motorized and electrical hand tools and equipment, and/or other activities that can be anticipated to generate excessive noise levels. The FOL and/or SSO will notify all Tetra Tech NUS and subcontractor personnel of high noise areas and operations, prior to work initiation. Notification of these personnel will take place in the following manner:

- Site-specific training – Review of the scope of work inherent hazards and control measures to be employed to minimize the effects of these hazards.

- Personnel will be notified through issuance of the Safe Work Permit.

- Information concerning hearing protection for operations not conducted under a Safe Work Permit will be conveyed verbally and documented within the project logbook.

- Information on high noise areas and hearing protection requirements is most effectively conveyed to Tetra Tech NUS and subcontractor personnel through the use of signs. The FOL and/or the SSO will post or otherwise identify areas of operations that exceed 85 dBA. If significant changes in noise levels occur (such as a shutdown or modification of an operating unit), the noise levels shall be re-evaluated by the SSO and/or the FOL to determine hearing protection needs.

5.0 HEARING PROTECTION

The following information establishes responsibility for the acquisition, selection, dispersal, training, care, storage and use, and evaluation of hearing protection.

5.1 Acquisition

When engineering and/or administrative controls are not feasible to control noise levels, hearing protection will be required. These hearing protection devices will be provided to employees

- Who may be exposed to noise levels in excess of 85 dBA.
- Employees who have not yet had a baseline audiogram.
- Employees who have experienced a >10 dB Standard Threshold Shift (STS) at frequencies of 2,000, 3,000, or 4,000 hertz range in either ear.

The FOL will arrange for hearing protection in the following manner

- Complete an Equipment Requisition indicating the types of hearing protection required and amounts. Remember additional quantities of protective devices may be required for site visitors. Approved site visitors should be equipped to the same level of protection as field personnel.

- When arranging for hearing protection device purchases through procurement the following actions should be taken

  1. Contact the PHSO for assistance in identifying the appropriate hearing protection types and performance criteria.

  2. Complete a Material Requisition sheet describing the type, attenuation capabilities, and quantities required.

  3. Turn in the completed Material Requisition to the Contract Procurement Officer.

5.2 Selection/Dispersal

Employees will be provided with a variety of hearing protection devices to choose from. They will select from these hearing protection devices, unless specific medical restrictions and/or qualifications have been established through the medical surveillance program. All hearing devices made available and approved for use will provide attenuation to lower noise exposures to no more than an 8-Hour TWA of 85 dBA.

The SSO and/or the PHSO will evaluate the attenuation factors of hearing protection devices and may modify selections based on sound level monitoring or personal dosimetry results. These completed documents are to be copied and forwarded to the PHSO upon completion.

The FOL and/or the SSO will be responsible for ensuring adequate stock of hearing protection is maintained and available at the project site for employees and approved site visitors.

Hearing protectors shall be replaced as necessary (per the manufacturer's recommendation).

Employees will be responsible for the care, cleaning, storage, and inspection of hearing protection issued.

5.3 Training

The Health Sciences Group will institute and maintain a training program in support of the HCP covering the following subject matter

- The elements of this HCP
- The mechanism of hearing
- The deleterious effects of excessive noise on hearing
- Medical surveillance of the participants of this program (i.e., audiometric testing).
- Controlling excessive noise through engineering, administrative, and Personal Protective Equipment (PPE)
- PPE – Types, selection, limitations and advantages
- Use, care, and storage of hearing protective devices
- Noise monitoring methodologies and reporting
- Record-keeping – Documentation, retention, and access

Training will be provided to all effected employees through mechanisms including, but not limited to, 40-Hour Hazardous Waste Site General Site Worker Training, 8-Hour Hazardous Waste Site General Site Worker Refresher Training, 8-Hour Management/Supervisory Training, annual Hearing Conservation Program refresher, and Project or Site-Specific training. In addition, training materials may be obtained from the HSM.

Note: Course curriculum for training obtained from outside vendors must be approved by the HSM.

5.4 Care

Individuals issued reusable hearing protection such as earmuffs and plugs will be responsible for the care and of those devices. This includes the removal of any debris using a light detergent with a water rinse, or as directed using manufacturer's instructions.

Disposable plugs are to be disposed of after each use.

5.5 Storage

Hearing protection approved for use will be stored in their individual manufacturer supplied packaging. When this is not possible, storage within suitable containers such as Ziplock bags after cleaning and drying is acceptable.

Hearing protective devices should be stored to

- Prevent distortion
- Prevent contact from chemicals and/or contaminants
- Away from direct sunlight and heat sources which may cause photolytic or thermal degradation

5.6 Use

Hearing protection shall be used in accordance with the employee's training, and as directed within the HASP, Safe Work Permits, as directed by signs, or as directed by the FOL and/or the SSO. Failure to comply with these requirements will result in disciplinary action. The FOL and/or the SSO are responsible for the enforcing the use of hearing protection at project specific locations.

5.7 Evaluation

The elements of this hearing conservation program and the implementation at project sites will be evaluated periodically through the existing health and safety audit function under the direction of the Health and Safety Manager. In addition to this function the program will be evaluated under the following conditions

- STS is indicated within a protected body of employees.
- Normal auditing procedures indicate discrepancies within the implementation of the HCP.

6.0 RECORD KEEPING

The following records will be maintained in support of this HCP

- Exposure measurements - This includes Sound Level Measurement Logs and/or the Noise Dosimetry Logs, and related records. Copies will be kept at the site while the originals are forwarded to the PHSO for review and record retention in the project file. Exposure measurement records will be maintained for a minimum of two years.

- Audiometric Testing Records – These records are maintained as part of the medical surveillance program and all employees who receive an audiogram will be provided a written copy of the results. These records will be retained the duration of the effected employees employment.

- Training Records – Training records for the 40-Hour, 8-Hour Refresher, 8-Hour Management/Supervisory course content is maintained by the HSM and at the project level. The FOL and/or the SSO will be responsible for obtaining from identified field personnel certificates of the most recent successful completion of these courses to be maintained at the site. Site-specific training concerning the elements of this HCP will be maintained at the project site.

Record retention will be performed in accordance with the time periods stated in 29 CFR 1910.95 (retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html and 1910.1020 http://www.osha-slc.gov/OshStd_data/1910_1020.html).

7.0 AUDIOMETRIC TESTING

Audiometric testing will be performed on all participants of this HCP based on measured or anticipated noise levels that they may be exposed. The purpose of this testing will be as follows

- Establish an initial or revised baseline audiogram, as applicable, of the participant's current hearing condition.
- Repeat audiograms, in order to track any changes within the participants hearing measured under the baseline examination.
- Provide a mechanism for exit audiograms for personnel leaving the employment of Tetra Tech NUS, or a change in job duties where participation in the HCP is no longer necessary.

These audiograms and documentation pertaining to these tests are administered and maintained under the Tetra Tech NUS Medical Surveillance Program.

ATTACHMENT A

WORK SITE
HEARING CONSERVATION PROGRAM

HEARING CONSERVATION PROGRAM

The following information pertaining to the use of hearing protection is to be completed by the Site Safety Officer (SSO), their duly appointed representative, or the Field Operations Leader (FOL). This work site portion of the Hearing Conservation Program (HCP) will be completed only if hearing protection is to be used in the completion of the assigned tasks as identified per the scope of work, in the work plan, the health and safety plan, bid specifications, or as determined through hazard assessment of the tasks and potential hazards which may be involved. Upon completion of the site-specific elements of this HCP, the Sound Level Measurement Log and/or the Noise Dosimetry Log should be copied and attached to the Safe Work Permit(s) for each activity directed by the HASP to be monitored. Permits and logs should then be forwarded to the Project Health and Safety Officer (PHSO) for evaluation.

Personnel Responsible For Program Completion

The following persons are available to provide assistance in all elements of this program including question/conflict resolution and modification variances. These persons exercise the primary responsibility for the implementation of this site-specific program.

I) **Site Safety Officer (Site HCP Administrator):**____________________ **Phone #:**____________

Field Operations Leader: ________________________________ **Phone #:**____________

Project Health and Safety Officer:______________________________ **Phone #:**____________

Health and Safety Manager: ________________________________ **Phone #:**____________

Personnel Who (by Way of Assignment) Will Wear Hearing Protection

The following list represents TtNUS or subcontractor personnel working under the provisions of this HCP. The persons listed below are included in this site-specific HCP and are required to wear hearing protection when performing tasks producing excessive noise.

II)

Personnel	Make/Model of Hearing Protective Devices to be used	Hearing Protection Noise Reduction Rating (NRR #)

III) Noise Evaluation Technique or Quantitative Noise Evaluations

Noise level monitoring performed on-site will be done to quantify noise levels generated during certain operations. Documentation of these measurements will be performed using either the Sound Level Measurement Log or the Noise Dosimetry Log provided in Figure 1 and Figure 2.

The Sound Level Monitoring

Sound level measurements can be used in establishing noise levels for persons working within the exclusion zone. Sound level monitoring will be performed using a Type II Sound Level Meter (SLM) set on the A-Weighted scale and on the SLOW response setting. This type of SLM survey is necessary when the general rule of thumb for noise levels is exceeded, in order to determine if hearing conservation is an issue, and if so, to set the boundaries for where hearing protection will be required. SLM surveys are also used to identify areas or operations where more specific noise exposure evaluations (using noise dosimetry) are appropriate.

General Rule of Thumb for Determining That Noise Levels May Be Excessive

If noise levels are loud enough that you need to raise your voice in order to communicate with another person who is within two feet of you, then noise levels may be excessive. In this case, hearing conservation issues must be considered and hearing protection must be used until and unless sound level monitoring or noise dosimetry indicate that it is not necessary.

To perform a SLM survey, first make sure that the SLM is on the proper settings as noted above, and ensure that it is properly calibrated in accordance with the manufacturer's instructions. Then, take **at least 3 random readings at each location** starting at the spot where the noise source is loudest and working your way away from the noise source, until you have readings that are below an average of 85 decibels on the A-weighted scale (dBA). You should position the SLM so that it is pointing perpendicular to the noise source (do not point the microphone directly at the noise source. This can result in inaccurate readings). "Random readings" means that you should hold the SLM in place and occasionally glance at the readout and record the reading that you see. You should not watch the readout and record the highest peak reading that you see. Pay particular attention to taking readings at any employee or subcontractor employee typical work locations (such as at the controls of a drill rig, at the area where samples are taken, etc.). Record your readings on a draft sketch of the work area (or on a floorplan if working inside of a building).

After you have taken enough readings to adequately characterize the work area, post calibrate the SLM and record the distance from the noise source where the average of the 3 readings was no more than 85 dBA (using Figure 1). All areas inside of the 85 dBA boundary line are to be designated as requiring hearing protection, and this must be communicated to all members of the field team. This can be accomplished by placing appropriate signs at the boundary line, posting Figure 1 at the work area, and by reviewing Figure 1 with the field team as part of a daily tailgate meeting or Safe Work Permit review.

Also, areas where average sound levels are 85 dBA or greater should be brought to the attention of the PHSO for considerations for noise dosimetry.

The Sound Level Measurement Log will be used in the following circumstances

- Setting exclusion zone boundaries based on noise levels generated.
- Establishing noise contours surrounding operations.

Noise Dosimetry Log

Noise dosimetry is used to accurately characterize the noise exposure that a person actually experiences during a working period. Dosimetry is much simpler to perform than a SLM survey, but it does involve the participation and cooperation of more people (namely, the workers who will wear the dosimeters). As with the use of any instrumentation, you need to closely follow the recommendations of the dosimeter manufacturer. Complete a Noise Dosimetry Log (Figure 2) for each dosimetry evaluation. In general, make sure that each dosimeter is properly calibrated before use, then attach the device to the worker so that the microphone is near the area of their head (i.e., at the collar). The worker should wear the device for the entire day, including breaks, and you should periodically check the device and record any notations of activities performed during the shift, using the Worker Activity Log in Figure 3. At the end of the shift, remove the dosimeter from the worker and post-calibrate it.

Noise Monitoring Results - Notification

The results of the noise monitoring (Sound Level Measurement Log and/or the Noise Dosimetry Log) will be copied and attached to the applicable Safe Work Permit(s). Copies of these documents will be forwarded to the PHSO for evaluation. In addition, a copy or the original shall be posted to inform personnel involved in the test as to the results. The SSO will also provide a narrative of the results to all personnel and subcontractor personnel who wish further explanation.

Calibration

All instruments used for sound level measurements and noise dosimetry will require calibration prior to use. All calibration will proceed as per manufacturer's instructions provided with the instruments. Information required for calibration is provided on the Sound Level and Noise Dosimetry Logs. Pre-and post-calibrations must be performed and recorded for all noise evaluations performed.

IIIA) Sound Level Measurement Log

The Sound Level Measurement Log (Figure 1) is to be used as a general record for sound level measurements recorded during operations. The diagram of the work area is to be completed by the SSO and/or the FOL. Information should include operator/helpers positions, support functions (sample tables, etc.), and noise measurements along the contours provided below. When designating the 85 dBA boundary line, make the approximate distance from the noise source so that it is clearly evident to site personnel where hearing protection is needed. A better approach would be to put signs in place where noise levels are above 85 dBA that hearing protection is required in this area. The contours provided below are set at ten feet intervals from the center, if alternate distances are desired indicate as such on the contour boundaries.

FIGURE 1

SOUND LEVEL MEASUREMENT LOG

<table>
<tr><td>Date of Survey</td><td colspan="2">Location of Survey</td><td>Surveyed By</td></tr>
<tr><td colspan="2">Sound Level Meter(Type)</td><td>Model #</td><td>Serial #</td></tr>
<tr><td colspan="2">Calibration Date</td><td colspan="2">Calibrated By</td></tr>
<tr><td colspan="2">Pre-Calibration Reading</td><td colspan="2">Post-Calibration Reading</td></tr>
<tr><td colspan="4">Activity Being Conducted:____________________
____
Equipment Used:____________________
Duration of Activity:____________________</td></tr>
<tr><td colspan="4">Hearing Protection Used?__________Type:__________NRR:__________</td></tr>
<tr><td colspan="4">Comments:____________________
____________________</td></tr>
</table>

IIIB) Noise Dosimetry Log (Figure 2)

This log will be employed when conducting Noise Dosimetry of operations or job classifications. This log contains the necessary information queues for worker information as well as calibration of the noise dosimeters to insure complete documentation. On the reverse side a running log of worker activity is provided. Upon completion of this log, a copy should be made for the file on site, and the original sent to the PHSO for evaluation.

NOISE DOSIMETRY LOG

DATE OF SAMPLE:___________

Individuals conducting the dosimetry initials below indicate that noise dosimeter(s) were calibrated, and the unit(s) test parameters verified, prior to sampling:

________ 90 dB Criterion

________ 5 dB Exchange

________ 80 dB Cut-off Threshold

_______ Pre-sample Calibration @ _____dBA

_______ Post-sample Calibration @____dBA

Calibrator:____________________

Type of Noise Dosimeter employed:____

Worker Sampled:______________________________ Dosimeter Identification No.____________________

S.S. Number:______________________________

Job Classification:____

Job/Task being performed:____

Equipment/Tools used:____

Type of Hearing Protection Employed:__________________________ Noise Reduction Rating:________

Representative Exposure: ________________ ________________ ________________

For: ________________ ________________ ________________

Start-time: ___:___ Lmax._______ Lavg.________ Lpk.________

Stop-time: ___:___

Elapsed-time: ___:___ Dose: _________% Projected Dose: __________%

Comments:____

____

____

____ Supervisor in Charge

____ SSO and/or FOL

ALSO COMPLETE WORKER ACTIVITY LOG ON REVERSE SIDE

FIGURE 3
WORKER ACTIVITY LOG

TEST HOUR	TASK(S)	*	LOCATION(S)
1			
2			
3			
4			
5			
6			
7			
8			

IV) Audiometric Testing

Audiometric testing is a standard part of the examination protocol in the Tetra Tech NUS Medical Surveillance Program. If based on scope of work, personnel or subcontractor personnel are required to wear hearing protection as part of their task assignment, it will be the SSO's or the FOL's responsibility to inquire whether their medical evaluation included audiometric testing. At all Tetra Tech NUS, Inc. project sites where hearing protection is required it is imperative that personnel be in a program of audiometric testing. For those who have not had even an initial (or baseline) evaluation, hearing protection will be required if Time-weighted are 8 hour exposure > 85 dBA.

V) Information Access

The implementation of this HCP requires information be made available to the participants of this program. Information to be made available include the following:

- Code of Federal Regulations, Subsection 1910.95 - This standard shall be posted on site accessible to all personnel. (retrievable at http://www.osha-slc.gov/OshStd_data/1910_0095.html).
- Monitoring Results – Information concerning quantitative monitoring will be posted accessible to all site personnel.
- Informational materials pertaining to the standard supplied to the employer by the Department of Labor.

IV) Record-Keeping

The following information will be maintained at the project site by the SSO and/or the FOL during the course of on-site activities.

- Exposure monitoring documentation (Sound Level Measurement and Noise Dosimetry Logs shall be maintained with the applicable Safe Work Permit). This information at project completion will be maintained in the project files for a period of no less than two years.
- Medical Surveillance information – Information concerning the individual's fitness for duty should include a declaration that the medical evaluation included establishing a baseline quantification of that persons hearing capabilities.
- Training – On project sites where noise is recognized as a potential hazard (either in the HASP, by following the general rule-of-thumb, or as a result of noise monitoring), hearing conservation training must be provided to al personnel working in these areas. This can be accomplished using Attachment 2.. If training is provided, in part or in whole regarding the subject matter minimum content documentation should be provided attesting to such.

ATTACHMENT VII

FIRE EXTINGUISHER

USE AND INSPECTION

FIRE EXTINGUISHER

USE AND INSPECTION

Fire Extinguisher Use and Inspection procedures will be conducted in support of the activities to be conducted at NCBC Gulfport. The following text is intended to provide general instruction to the field personnel charged with this responsibility.

Fire Extinguisher Use

All personnel trained in incidental response measures may be required to use and operate a fire extinguisher in response to an incipient stage fire. Therefore, the following instruction is provided and will be conveyed to all field personnel as part of site-specific training.

To use a portable fire extinguisher, the user should be familiar with the operation of the specific fire extinguisher located in the workplace. The following procedure will properly extinguish a small fire.

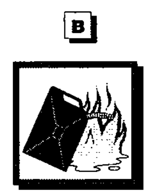
1) IDENTIFY THE TYPE OF FIRE (CLASS A, B, C, D).

CLASSES OF FIRE/FIRE EXTINGUISHER IDENTIFICATION

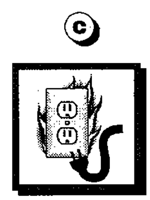
Fire is divided into four classes for easy identification and extinguishment. The type of fuel or ignition source will determine the type of extinguishing medium required.

Class A - Ordinary combustibles (wood, paper, rubber, plastic, and cloth). Extinguishers suitable for Class A fires should be identified by a triangle containing the letter "A." If colored, the triangle is green.

Class B - Flammable liquids, gases, and greases. Extinguishers suitable for Class B fires should be identified by a square containing the letter "B." If colored, the square is red. <u>This type of extinguisher is effective on small petroleum product fires</u>.



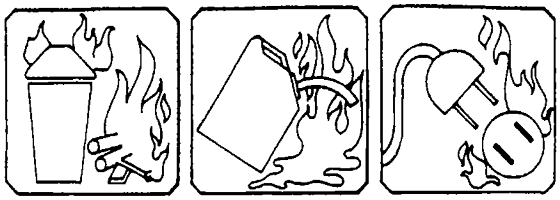
Class C - Electrically energized systems. Extinguishers suitable for Class C fires should be identified by a circle containing the letter "C." If colored, the circle is blue.



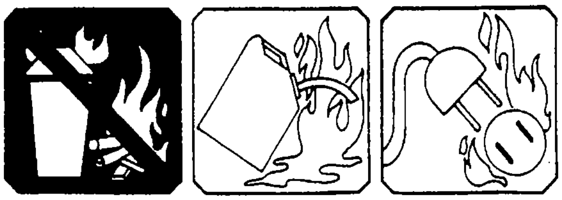
Class D - Combustible metals (sodium, magnesium, phosphorus). Extinguishers suitable for fires involving metals should be identified by a five-pointed star containing the letter "D." If colored, the star is yellow.

<u>Note: Water and other extinguishing media, such as carbon dioxide and dry chemicals, are ineffective on metal fires.</u>

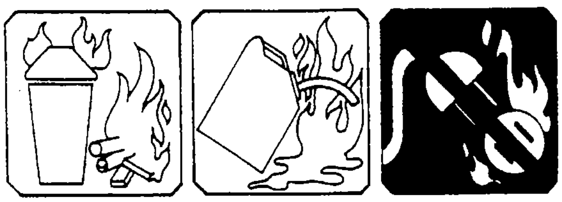
New NFPA Markings



Class A, B, C



Class B, C



Class A, B

Class A

Mutli-class (ABC) Fire extinguishers will be provided for use on site. If you will buy a Fire Extinguisher, this is the type recommended. Size or rating recommended is 2 1/2 to 5 lbs.

1. Determine whether the extinguisher is adequate for this fire.

Rating number – The rating number assigned to a fire extinguisher is based on the capabilities of that fire class, for example

Class 5 A – Will provide extinguishing capabilities equal to that of 5 gallons of water.

Class 20 B - Will provide extinguishing capabilities equal to 20 square feet of flammable liquid burning.

Class C & D are not rated as to their limitations.

2. If adequate, hold the extinguisher upright and pull the ring pin.
3. Stand back 10 feet and aim at base of fire. Be careful not to spread burning material with pressurized extinguishing material.
4. Squeeze lever; sweep extinguisher in a side-to-side motion.

Portable Fire Extinguisher Placement/Mounting

Portable Fire Extinguishers will be placed/mounted in clear view in the areas where flammable materials are stored and/or dispensed. Mounting and placement of fire extinguishers will follow the following requirements

Fixed Locations (Flammable Storage)

- Extinguisher location will be marked by a red painted post to indicate extinguisher location
- The travel distance to access a fire extinguisher shall be no greater than 50 feet.
- The fire extinguisher will be mounted at a maximum height of four feet.

Mobile Locations (Drill Rigs, Support Vehicles)

All vehicles carrying fuel containers or used in the dispensing of fuel will carry at a minimum a 5 pound rated fire extinguisher.

Portable Fire Extinguisher Inspection

All fire extinguishers used in support of this field effort will be inspected on the following frequencies:

- A certified provider will perform maintenance checks of fire extinguishers at least once a year. A tag attached to the neck of the fire extinguisher will indicate documentation of the maintenance check.

- All fire extinguishers will have a current hydrostatic inspection. For the type of extinguishers selected for use at NCBC Gulfport hydrostatic inspections are required every 5 years.

- All fire extinguishers will be inspected monthly. The monthly inspection will cover the following
  - Are the fire extinguisher(s) placed in their designated location(s)?
  - Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?
  - Is the access impeding travel to the fire extinguisher blocked or restricted in any way?
  - Has the fire extinguisher been partially or completely discharged?
  - Is there signs of obvious physical damage?
  - Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?

This inspection shall be documented on the attached tag provided by the maintenance/hydrostatic inspection service.

FIRE EXTINGUISHER CHECKLIST

NCBC GULFPORT

Project Name: NCBC Gulfport	CTO 0278	Date of Inspection:______________
Fire Extinguisher Identification Number:____________		Fire Extinguisher Location: ______________________________

Measurement Criteria	Yes	No	N/A	Needs Repaired
Are the fire extinguisher(s) placed in their designated location(s)?				
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?				
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?				
Has the fire extinguisher been partially or completely discharged?				
Is there signs of obvious physical damage?				
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?				

Project Name: NCBC Gulfport	CTO 0278	Date of Inspection:______________
Fire Extinguisher Identification Number:____________		Fire Extinguisher Location: ______________________________

Measurement Criteria	Yes	No	N/A	Needs Repaired
ARE THE FIRE EXTINGUISHER(S) PLACED IN THEIR DESIGNATED LOCATION(S)?				
Is the location conspicuously marked (Top 18 inches of the mounting pole to be painted red)?				
Is the access impeding travel to the fire extinguisher blocked or restricted in any way?				
Has the fire extinguisher been partially or completely discharged?				
Is there signs of obvious physical damage?				
Does the fire extinguisher shows sufficient pressure and are all of the tamper indicators are in place?				

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN (QAPP)

Quality Assurance Project Plan
for
Site 8 – Herbicide Orange Storage Area
and
Off-Base Area of Contamination

Naval Construction Battalion Center
Gulfport, Mississippi

NAVFAC
Naval Facilities Engineering Command

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0272

December 2004

060304/P

QUALITY ASSURANCE PROJECT PLAN
FOR
SITE 8 – HERBICIDE ORANGE STORAGE AREA
AND
OFF-BASE AREA OF CONTAMINATION

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Southern Division
Naval Facilities Engineering Command
2155 Eagle Drive
North Charleston, SC 29406

Submitted by:
Tetra Tech NUS, Inc.
661 Andersen Drive
Pittsburgh, Pennsylvania 15220

CONTRACT NUMBER N62467-94-D-0888
CONTRACT TASK ORDER 0272

DECEMBER 2004

PREPARED UNDER THE SUPERVISION OF:

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APPROVED FOR SUBMITTAL BY:

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PITTSBURGH, PENNSYLVANIA

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ACRONYM LIST

AOC	Area of Contamination
%R	percent recovery
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	Contaminant of Concern
CTO	Contract Task Order
CVAA	Cold Vapor Atomic Absorption
DQO	Data Quality Objective
EISOPQAM	Environmental Investigations Standard Operation Procedure and Quality Assurance Manual
EMPC	Estimated Maximum Potential Concentration
FFS	Focused Feasibility Study
FOL	Field Operations Leader
FTMR	Field Task Modification Request
GC	Gas Chromatograph
GFAA	Graphite Furnace Atomic Absorption
HASP	Health and Safety Plan
HO	Herbicide Orange
HR	High Resolution
HPLC	High Performance Liquid Chromatograph
HSM	Health and Safety Manager
ICP	Inductively-Coupled Plasma Atomic-Emission Spectrometer
LCS	Laboratory Control Sample
MCL	Maximum Contamination Level
MDEQ	Mississippi Department of Environmental Quality
MDL	Method Detection Limit
MS	Mass Spectrometer
MS/MSD	Matrix Spike/Matrix Spike Duplicate
NCBC	Naval Construction Battalion Center
NELAC	National Environmental Laboratory Accreditation Conference
NFESC	Naval Facilities Engineering Service Center
NIST	National Institute of Science and Technology
ng/kg	nanograms per kilogram
NTU	Nephelometric Turbidity Unit
ORP	Oxidation-Reduction Potential
PARCC	Precision, Accuracy, Representativeness, Comparability, Completeness

pg/L	picograms per liter
PM	Program Manager
PRG	Preliminary Remediation Goal
ppt	parts per trillion
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
RA	Remedial Action
RBC	Risk-Based Concentration
RD	Remedial Design
RDL	Required Detection Limit
RL	Reporting Limit
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RQL	Required Quantitation Limit
SDG	Sample Delivery Group
SOP	Standard Operating Procedure
TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TCL	Target Compound List
TRG	Target Remediation Goal (MDEQ's)
TOM	Task Order Manager
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
VSAP	Verification Sampling and Analysis Plan

1.0 PROJECT DESCRIPTION

1.1 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared by Tetra Tech NUS, Inc. (TtNUS) on behalf of the United States Navy Southern Division Naval Facilities Engineering Command and the Naval Construction Battalion Center (NCBC) Gulfport, Gulfport, Mississippi, under the Comprehensive Long-Term Environmental Action Navy (CLEAN) III Contract Number N62467-94-D-0888, Contract Task Order (CTO) 272. The QAPP and other associated documents, including the United States Environmental Protection Agency (USEPA) Region IV Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM), Verification Sampling and Analysis Plan (VSAP) dated May 2003 prepared by TtNUS, and the Health and Safety Plan (HASP), constitute the project planning documents for the VSAP program to be performed to support the Remedial Design (RD)/Remedial Action (RA) for Site 8, Herbicide Orange Storage Area, and on-base and off-base areas that have been impacted by the storage of Herbicide Orange (HO) at Site 8 at the NCBC Gulfport, Gulfport, Mississippi.

This QAPP presents the organization, objectives, planned activities, and specific quality assurance/quality control (QA/QC) procedures associated with the sampling program. Specific protocols for sampling, sample handling and storage, chain-of-custody, and laboratory and field analyses are described within this document. All QA/QC procedures are structured in accordance with applicable technical standards, the Naval Facilities Engineering Service Center (NFESC) guidance document Navy Installation Restoration Chemical Data Quality Manual (1999), and USEPA Region 4 and Mississippi Department of Environmental Quality (MDEQ) requirements, regulations, guidances, and technical standards.

1.2 FACILITY DESCRIPTION

A description of the NCBC Gulfport, Mississippi is provided in Section 2.0 of the VSAP.

1.3 SITE HISTORY

A description of Site 8 and on-base and off-base areas impacted by the past storage of HO at Site 8 is provided in Section 2.0 of the VSAP.

1.4 PROJECT OBJECTIVES

This section discusses the overall project objectives, the anticipated target parameters, and intended data uses for both field and laboratory analytical data.

1.4.1 Overall Project Objectives

During the upcoming RA, dioxin-contaminated media from areas impacted by the past storage of HO at Site 8 will be excavated, blended, stabilized, and consolidated/landfilled at Site 8A. A protective cap will be placed over the stabilized material. The overall purpose of verification sampling is to confirm that remedial objectives for the RA are sufficiently achieved. Specifically, verification sampling will:

- Confirm that dioxin-contaminated sediments excavated from the on-base drainage channels within and contiguous to Site 8 and from the off-base area of contamination (AOC) located north of the base are successfully removed to levels less than the preliminary remediation goal (PRG) of 38.2 nanograms/kilogram (ng/kg).

- Verify that dioxin concentrations in the groundwater surrounding the stabilized material do not exceed the PRG of 30 picograms per liter (pg/L).

- Verify that off-base groundwater does not contain dioxin concentrations greater than the PRG of 30 pg/L (to be implemented after the completion of sediment removal in the off-base AOC).

- Verify that the subgrade of the materials handling pad to be used during the RA contains dioxin concentrations less than 38.2 ng/kg.

Project objectives are discussed in further detail in Section 3.0 of the VSAP.

1.4.2 Project Target Parameters and Intended Data Uses

This section discusses the field and laboratory analytical information to be generated during the course of the investigation. Field parameters and intended data uses are discussed in Section 1.4.2.1. Laboratory parameters and intended data uses are discussed in Section 1.4.2.2.

1.4.2.1 Field Parameters

Field parameters will include those parameters associated with groundwater, soil, and sediment sampling and analysis. All field measurements will be completed using simple field instrumentation.

Field parameters including specific conductance, pH, turbidity, temperature, and oxidation-reduction potential (ORP) will be completed for all groundwater samples. Specific conductance, pH, turbidity and temperature will be used to support monitoring well purging of stagnant water from well casings. Specific conductance and pH will also be used as general indicators of water quality. Specific conductance, pH, turbidity, and temperature will be measured using field water-quality meters. ORP will be measured using an ORP meter. Further details regarding field-sampling methods are provided in Section 16 of the USEPA EISOPQAM (2001).

1.4.2.2 Laboratory Parameters

Dioxins and furans are the only chemicals of concern (COCs) established in areas affected by the past storage of HO at Site 8. Analytical data will be used to determine whether remedial objectives for the RA have been achieved.

All groundwater samples will be analyzed for Target Compound List (TCL) (as defined by the Contract Laboratory Program Statement of Work OLM04.2) dioxins/furans. Table 1-1 provides a list of all target compounds and associated Required Quantitation Limits/ Required Detection Limits (RQLs/RDLs) for dioxins/furans. The RQLs listed in the table meet the required Maximum Contamination Limits (MCLs) as provided in the USEPA Drinking Water Regulations and Health Advisories, October 1996). If an MCL is not available for any compound or analyte, the USEPA Region IX Risk-Based Concentrations (RBCs) are used for comparison. There are no specific reporting limits listed in Table 1-1 because the reporting limits for these analyses are dependent on the laboratory.

All soil and sediment samples will also be analyzed for TCL dioxins/furans. Table 1-1 provides a summary of all target compounds associated RQLs for dioxins/furans. The RQLs listed in the tables meet the required MDEQ Tier 1 Target Remediation Goals (TRGs) for unrestricted use.

All soil and sediment samples will be analyzed for dioxins using USEPA SW-846 Method 4025m. All groundwater samples will be analyzed for dioxins using USEPA SW-846 Method 8290. Ten percent of the samples locations that undergo Method 4025m analysis will also be sampled and analyzed using Method 8290 for confirmation purposes.

1.5 SAMPLE NETWORK DESIGN AND RATIONALE

The sample network design and rationale are discussed in Section 3.0 of the VSAP.

1.6 PROJECT SCHEDULE

The project schedule is to be determined.

TABLE 1-1

METHOD SW-846 8290 ANALYTICAL QUANTITATION LIMITS
DIOXIN/FURAN LIST
NCBC GULFPORT SITE 8 QAPP

	RQL(1)	
	Solid Samples	**Aqueous Samples**
Dioxins/Furans	**ppt**	**ppt**
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1.0	0.01
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	1.0	0.01
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	2.5	0.025
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	2.5	0.025
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	2.5	0.025
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HPCDD)	2.5	0.025
1,2,3,4,6,7,8,9-Octachlorodibenzo-p-dioxin (OCDD)	5.0	0.05
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	1.0	0.01
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	1.0	0.01
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	1.0	0.01
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	2.5	0.025
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	2.5	0.025
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	2.5	0.025
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	2.5	0.025
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	2.5	0.025
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	2.5	0.025
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	5.0	0.05

1 RQL Required Quantitation Limit
ppt = part per trillion

2.0 PROJECT ORGANIZATION

The various QA and management responsibilities of key project personnel are defined in the following paragraphs.

CLEAN Program Manager - The TtNUS Program Manager is responsible for the execution of all contractual obligations. He/she serves as the primary Program point of contact for the client and provides an interface between the Navy and the project staff. The TtNUS CLEAN Program Manager is Ms. Debbie Wroblewski.

CLEAN Task Order Manager - The Task Order Manager (TOM) is responsible for project performance, budget, and schedule, and for ensuring the availability of necessary personnel, equipment, subcontractors, and services. He/she will direct the development of the field program, evaluation of findings, determination of conclusions and recommendations, and preparation of technical reports. The TtNUS TOM is Mr. Robert Fisher.

Field Operations Leader/Sampling Coordinator – The Field Operations Leader (FOL) is responsible for providing on-site supervision of day-to-day activities on the project. The FOL serves as the primary on-site contact with the client and subcontractors. The FOL is also responsible for all field QA/QC and safety-related issues as defined in the HASP. In addition, the FOL will coordinate the schedule of field sampling activities with the schedule and capacity requirements of the selected analytical laboratories. All field activities will be coordinated to assure that environmental sampling is conducted in a manner that complies with all QA/QC requirements and is in compliance with holding time and analytical procedure requirements. The TtNUS FOL is Mr. Jason Bourgeois.

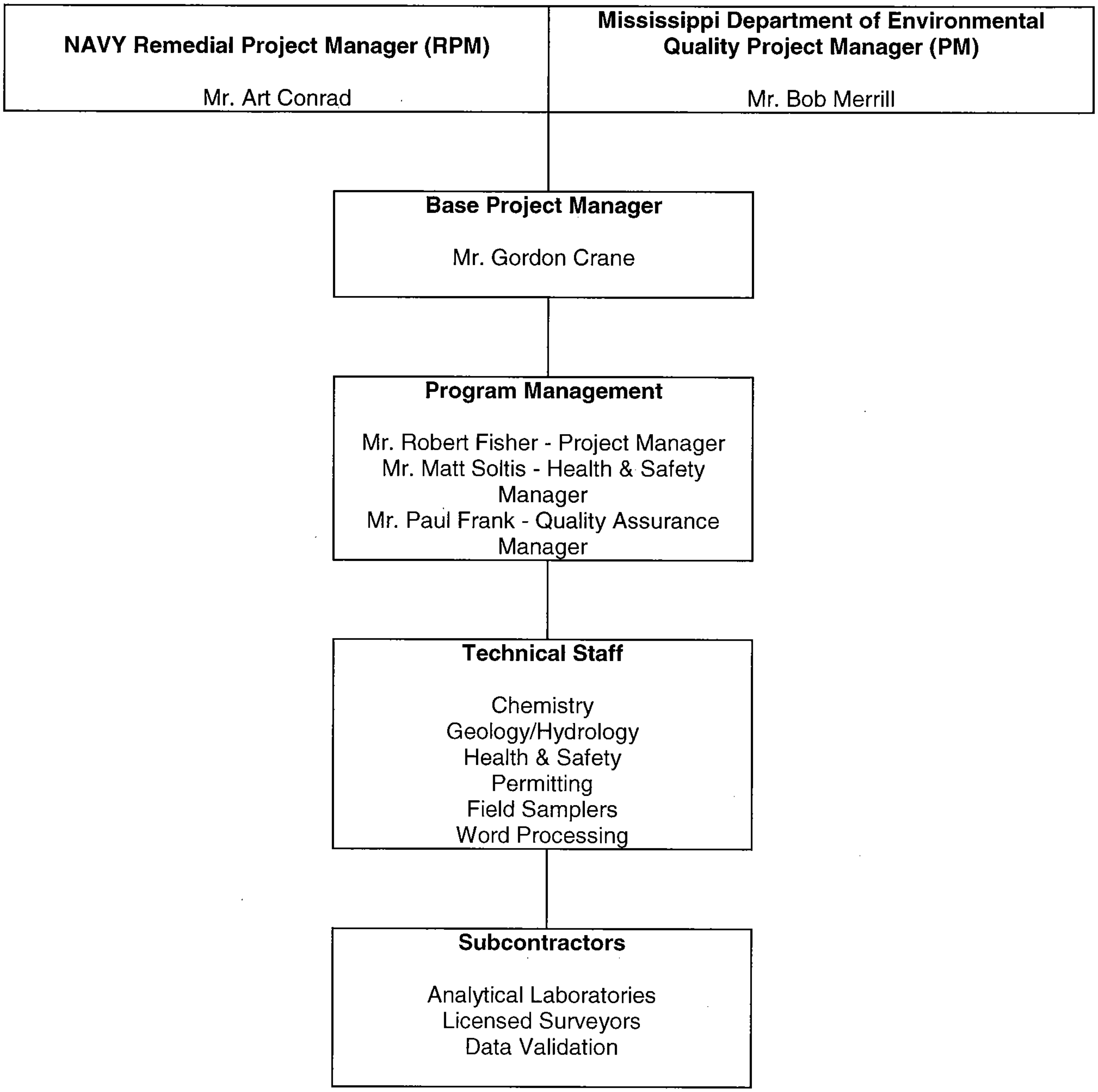
Health and Safety Manager - The Program Health and Safety Manager (HSM) will review and internally approve the HASP tailored to the specific needs of the investigation. In consultation with the TOM and FOL, the HSM will ensure that an adequate level of personal protection exists for anticipated potential hazards for all field personnel. As the HSM does not report to either the Program or Task Order Manager, his actions are not dictated by Program or project constraints (such as budget and schedule) other than the assurance of appropriate safeguards while conducting investigation activities. The TtNUS HSM is Mr. Matthew Soltis, CIH.

Quality Assurance Manager - The TtNUS Quality Assurance Manager (QAM) is Mr. Paul Frank. The QAM operates independently of the TOM and is responsible for all Program-wide, QA issues and the development of the QAPP. The QAM appoints a project Quality Assurance Officer (QAO) for the project. The specific responsibilities of the QAO include reviewing laboratory reports to ensure that all the QA/QC requirements have been met and inspecting work activities and project deliverables to make sure that QC activities are not compromised. The QAO will communicate issues of non-compliance directly to the TOM and the QAM. The TtNUS QAO is Mr. Howard Engle.

Project Laboratories – The laboratory will be subcontracted to perform the routine chemical analyses for collected environmental samples. The laboratory is responsible for checking laboratory quality against the requirements of the QAPP before the reports are transferred to TtNUS.

FIGURE 2-1

PROJECT ORGANIZATION
NCBC GULFPORT, GULFPORT, MISSISSIPPI



3.0 QUALITY ASSURANCE OBJECTIVES FOR MEASUREMENT DATA

The overall QA objective for this project is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide results that support the attainment of project data quality objectives. Intended data uses are described in Section 1.4 of this QAPP. Specific procedures for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, reporting of data, internal QC, audits, preventive maintenance of field and laboratory equipment, and corrective action are described in other sections of this QAPP.

The PARCC parameters (precision, accuracy, representativeness, comparability, and completeness) are qualitative and/or quantitative statements regarding the quality characteristics of the data used to support project data quality objectives and ultimately, environmental decisions. These parameters are discussed in the remainder of this section. Specific routine procedures used to assess the quantitative parameters (precision, accuracy, and completeness) are provided in Section 12.0.

3.1 PRECISION

Precision is a measure of the amount of variability and bias inherent in a data set. Precision describes the reproducibility of measurements of the same parameter for samples under similar conditions. The equation for determining precision is provided in Section 12.2.

3.1.1 Field Precision Objectives

Duplicate field measurements (i.e., turbidity readings with a Horiba) for aqueous matrix samples will not be required. In lieu of matrix spikes (MSs) and independent QC check standards, more frequent continuing calibrations will be performed. Field measurement meters will be calibrated immediately before the initial analysis and every 4 hours after the initial calibration while sampling.

3.1.2 Laboratory Precision Objectives

Laboratory precision QC samples are analyzed at a frequency of 5 percent (i.e., one quality control sample per 20 environmental samples). Laboratory precision is measured via comparison of calculated Relative Percent Difference (RPD) values and precision control limits specified in the analytical method or by the laboratory's QA/QC Program.

Precision for organic analyses will be measured via the RPDs for MS/matrix spike duplicate (MS/MSD) samples. Table 3-1 presents precision control limits for MS/MSD RPDs for dioxin/furan analyses.

3.2 ACCURACY

Accuracy is the degree of agreement between the observed value and an accepted reference value. The equation for determining accuracy is provided in Section 12.1.

3.2.1 Field Accuracy Objectives

The determination of accuracy in the field is not required. In lieu of MS and independent QC check standards, more frequent continuing calibrations will be performed. Field measurement meters will be calibrated immediately before the initial analysis and every 4 hours after the initial calibration while sampling.

3.2.2 Laboratory Accuracy Objectives

Accuracy in the laboratory is measured through the comparison of a spiked sample result against a known or calculated value expressed as a percent recovery (%R). Percent recoveries are derived from the analysis of known amounts of compounds spiked into deionized water [i.e., laboratory control sample (LCS) analysis] or into actual samples (i.e., surrogate or MS analysis). LCS analyses measure the accuracy of laboratory operations. Surrogate and MS analyses also measure the accuracy of laboratory operations but as affected by the sample matrix. LCS and/or MS analyses are performed with a frequency of one per 20 associated samples of like matrix. Surrogate spike analysis is performed for all chromatographic organic analyses. Laboratory accuracy is assessed via comparison of calculated %Rs with accuracy control limits specified in the analytical method or by the laboratory's QA/QC Program.

Accuracy will be measured via the %Rs for surrogate spikes and MS/MSDs. Table 3-2 presents control limits for LCS spike recoveries for dioxins/furans. Tables 3-3 and 3-4 present control limits for matrix and surrogate spike recoveries, respectively, for Dioxins/Furans.

3.3 COMPLETENESS

Completeness is a measure of the amount of usable, valid analytical data obtained, compared to the amount expected. Completeness is typically expressed as a percentage. The equation for completeness is presented in Section 12.3.

The ideal objective for completeness is 100 percent (i.e., every sample planned to be collected is collected; every sample submitted for analysis yields valid data). However, samples can be rendered unusable during shipping or preparation (e.g., bottles broken or extracts accidentally destroyed), errors can be introduced during analysis (e.g., loss of instrument sensitivity, introduction of ambient laboratory contamination), or strong matrix effects can skew analytical results (e.g., extremely low MS recovery).

These instances may result in data that do not meet QC criteria. Based on these considerations, 95 percent is considered an acceptable target for the data completeness objective. If critical data points are lost, resampling and/or reanalysis might be required.

As further discussed in Section 11.2.2, 100 percent of the laboratory data for the NCBC Gulfport investigation program will undergo a full validation review. Data rejected as a result of the review process will be treated as unusable data unless additional review shows that the data are usable.

3.4 REPRESENTATIVENESS

Representativeness is an expression of the degree to which the data accurately and precisely depict the actual characteristics of a population or environmental condition existing at an individual sampling point. Use of standardized sampling, handling, analytical, and reporting procedures ensures that the final data accurately represent actual site conditions.

3.4.1 Measures to Ensure Representativeness of Field Data

Representativeness depends on the proper design of the sampling program and it will be achieved by ensuring that the VSAP is followed and that proper sampling techniques are used. The sampling network for the VSAP was designed to provide data representative of site conditions. During development of this network, consideration was given to the baseline condition determined from prior sampling and analytical data. The rationale of the sampling network is discussed in detail in Section 3.0 of the VSAP.

3.4.2 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory data is ensured by using the proper analytical procedures, meeting sample holding times, and analyzing and assessing duplicate samples.

3.5 COMPARABILITY

Comparability is defined as the confidence with which one data set can be compared to another (e.g., between sampling points; between sampling events). Comparability is achieved by using standardized sampling and analysis methods and data reporting formats (including use of consistent units of measure). Additionally, consideration is given to seasonal conditions and other environmental variations that could influence data results.

3.5.1 Measures to Ensure Comparability of Field Data

Comparability is dependent upon the proper design of the sampling program and will be achieved by ensuring that the VSAP is followed. It also depends on recording field measurements using the correct units. Field measurement units are further discussed in Section 11.1.1.

3.5.2 Measures to Ensure Comparability of Laboratory Data

Analytical data will be comparable when similar sampling and analytical methods are used and documented. Results will be reported in units that ensure comparability with previous data and with current State and federal standards and guidelines. Laboratory measurement units are further discussed in Section 11.1.2.

3.6 LEVEL OF QUALITY CONTROL EFFORT

Rinsate blank, method blank, field and laboratory duplicate, laboratory control, and MS samples will be analyzed to assess the quality of the data resulting from the field sampling and analytical programs.

External QC measures to be collected as part of verification sampling activities consist of field duplicates and equipment rinsate blanks. Volatile organic compounds will not be collected as part of VSAP activities; consequently, trip blanks will not be collected. Information gained from these analyses further characterizes the level of data quality obtained to support project goals. Each of these types of field QC samples undergo the same preservation, analysis, and reporting procedures as the related environmental samples. Each type of field QC sample is discussed below.

Field duplicates are two samples collected independently at a sampling location (e.g., sediment). Field duplicates are collected and analyzed by the laboratory for all chemical constituents to measure the precision of the sampling and analysis methods employed. The level of the QC effort will be one field duplicate for every 5 to 9 samples and then 10 percent of the number of additional investigative samples.

Equipment rinsate blanks are obtained under representative field conditions by collecting the rinse water generated by running analyte-free water through sample collection equipment after decontamination and prior to use. At least one equipment blank will be collected per day per matrix. If pre-cleaned, dedicated, or disposable sampling equipment is used, one rinsate blank per type of equipment used must be collected as a "batch blank." Rinsate blanks are analyzed by the laboratory for the same chemical constituents as the associated environmental samples. Equipment blanks are further discussed in Sections 5.2 and 5.13.10 of the EISOPQAM (USEPA, 2001).

Method blank samples are generated within the laboratory and used to assess contamination resulting from laboratory procedures. Samples with positive results corresponding to positive results in the method blank will be designated with a qualifier by the laboratory. Method blanks are further discussed in Section 10.2 of this QAPP.

MS/MSD samples are investigative samples spiked with known quantities of target analytes. MS/MSDs provide information about the effect of the sample matrix on the measurement methodology. One MS/MSD sample will be collected/designated for every 20 or fewer investigative samples per sample matrix.

The level of QC effort for analytical testing will conform to the appropriate analytical method, as specified in Table 8-1.

TABLE 3-1

PRECISION CONTROL LIMITS (RPDs)[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES
SITE 8 QAPP
NCBC GULFPORT, MISSISSIPPI

Chemical	Aqueous Samples	Soil Samples
Dioxins/Furans [2]	**RPD**	**RPD**
All dioxins/furans	25	25

1 RPD Relative Percent Difference as described in Section 12.2
2 USEPA Method SW-846 8290.

TABLE 3-2

ACCURACY CONTROL LIMITS (%R)[1]
LABORATORY CONTROL SAMPLE
SITE 8 QAPP
NCBC GULFPORT, MISSISSIPPI

Chemical	**Aqueous Samples**	**Soil Samples**
Dioxins/Furans [2]	**%R**	**%R**
All dioxins/furans	70 - 130	25

1 %R Percent Recovery
2 USEPA Method SW-846 8290.
NA Not Applicable

TABLE 3-3

ACCURACY CONTROL LIMITS (%R)[1]
MATRIX SPIKE/MATRIX SPIKE DUPLICATE SAMPLES
SITE 8 QAPP
NCBC GULFPORT, MISSISSIPPI

Chemical	Aqueous Samples	Soil Samples
Dioxins/Furans [2]	**%R**	**%R**
All dioxins/furans	70 - 130	25

1 %R Percent Recovery
2 USEPA Method SW-846 8290.
NA Not Applicable

TABLE 3-4

ACCURACY CONTROL LIMITS (%R)[1]
SURROGATE SPIKES
NCBC GULFPORT, MISSISSIPPI
SITE 8 QAPP

Chemical	Aqueous Samples	Soil Samples
Dioxins/Furans [2]	**%R**	**%R**
1,2,3,4-TCDD	75 - 125	75 - 125
1,2,3,7,8,9-HxCDD	75 - 125	75 - 125

1 %R Percent Recovery
2 USEPA Method SW-846 8290.
NA Not Applicable

4.0 DATA QUALITY OBJECTIVES

4.1 INTRODUCTION

The Data Quality Objective (DQO) Process is a planning approach used to determine the appropriate environmental data collection activities for a specific project. The DQOs, generated by the DQO Process define the criteria that a data collection design should satisfy: purpose of the data collection; what the data should represent; the requirements for the quality of the data; and when, where, and how to collect samples or measurements. Satisfying the DQOs will result in a data collection design that meets all performance criteria and any other requirements. The DQO Process has been conducted by all involved parties on an informal basis throughout the investigation of Site 8 and contiguous areas affected by past HO storage at Site 8. This section of the QAPP will address the DQOs generated through the informal DQO Process.

4.2 PROJECT AND DATA OBJECTIVES

A detailed description of the project objectives are provided in Section 3.2 of the VSAP. These objectives are summarized as follows.

- **Off-base AOC sediments** - During the RA, the Navy will remove approximately 27,800 cubic yards of dioxin-contaminated sediment located on 11.5 acres of off-base property owned by Mr. G.D. Arndt (the Arndt property) and Mr. P.W. Bennett (the Bennett property). Upon completion of excavation activities, verification sampling and analysis will be performed to confirm that remaining dioxin concentrations in the off-base AOC sediment are less than the PRG of 38.2 ng/kg established for the Arndt and Bennett properties established in the Site 8 Focused Feasibility Study (FFS).

- **On-base drainage channel sediments** – During the RA, the Navy will remove approximately 17,600 cubic yards of sediment contained within the on-base drainage channels. Upon completion of excavation activities, verification sampling and analysis will be performed to confirm that remaining dioxin concentrations in the off-base AOC are less than the PRG of 38.2 ng/kg established for the on-base drainage channels in the Site 8 FFS.

- **Site 8 groundwater** – The soil ash currently stored at Site 8A and the excavated sediment from the on-base drainage channels and off-base AOC and will be homogenized, stabilized with Portland cement, and consolidated/landfilled at Site 8A. A protective cap will be placed over the stabilized material. Over the long term, groundwater will be sampled from permanent monitoring wells downgradient of Site 8 to verify that dioxins within the stabilized media are not leaching to the groundwater at unacceptable levels (greater than the PRG of 30 pg/L).

- **Off-base AOC groundwater** – After excavation activities in the off-base AOC are completed, temporary monitoring wells will be installed and sampled to verify that dioxin concentrations in off-base AOC groundwater are within acceptable levels (less than the PRG of 30 pg/L).

- **Materials handling pad subgrade (Site 8B Soil)** – During the RA, a bermed and lined materials handling pad will be constructed at Site 8B but will be removed upon completion of RA activities. Upon removal of the materials handling pad, the remaining soils (the pad's subgrade) will be sampled to verify that dioxin concentrations are below the MDEQ Tier 1 soil TRG of 38.2 ng/kg for restricted (industrial) use.

4.3 ANALYTICAL OBJECTIVE

Analytical parameters were chosen based on the previous investigations conducted at NCBC Gulfport and the off-base AOC. The erosion and transport of HO-contaminated soil at Site 8 has resulted in dioxins and furans migrating through on-base drainage channels and into the off-base AOC. All soil, sediment, and groundwater samples will be analyzed using the high-resolution USEPA SW-846 8290 and 4025m analytical methods. These results will allow for a comparison of dioxins to the Tier 1 TRG unrestricted and restricted levels.

4.4 DATA QUALITY OBJECTIVE

Data quality is discussed in Sections 11.0 and 12.0 of this QAPP. These sections specifically address data reduction, validation, reporting, precision, accuracy, completeness, and usability.

4.5 SAMPLING AND MEASUREMENT PROCEDURES

Sampling and measurement procedures are specifically discussed in Section 5.0 of this QAPP.

5.0 SAMPLING PROCEDURES

The specific types of field activities associated with NCBC Gulfport Site 8 verification sampling are discussed in the VSAP and will follow the EISOPQAM. In addition, the EISOPQAM and the VSAP address the following field investigation tasks:

- Monitoring well purging – Section 7.2, EISOPQAM
- Sample containers, preservatives, and volume requirements – Appendix A, EISOPQAM
- Field measurements – Section 16, EISOPQAM
- Decontamination procedures – Appendix B, EISOPQAM; Section 4.0, VSAP
- Investigation derived waste – Section 5.15, EISOPQAM; Section 4.0, VSAP
- Sample identification system – Section 5, Subsection 5.3.2, TtNUS CompQAP
- Sample packaging and shipping procedures – Appendix D, EISOPQAM
- Recordkeeping – TtNUS Corporate Standard Operating Procedure (SOP) SA-6.3 (Attachment 1)
- Sample container, preservation, and laboratory holding time requirements for sample collection - Section 5.0, VSAP.

6.0 CUSTODY PROCEDURES

Custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files. Final evidence files, including all originals of laboratory reports and purge files, are maintained under document control in a secure area. A sample or evidence file is under custody if:

- The item is in the actual physical possession of an authorized person, or;
- The item is in view of the person after being in his or her possession, or;
- The item was placed in a secure area to prevent tampering; or
- The item is in a designated and identified secure area with access restricted to authorized personnel only.

The chain-of-custody report is a multi-part, standardized form used to summarize and document pertinent sample information such as sample identification and type, matrix, date and time of collection, preservation, and requested analyses. Furthermore, through the sequential signatures of various sample custodians (e.g., sampler, airbill number, laboratory sample custodian), the chain-of-custody report documents sample custody and tracking. A "cradle-to-grave" sample tracking system will be employed. Custody procedures apply to all environmental and associated field QC samples obtained as part of the data collection system.

6.1 FIELD CUSTODY PROCEDURES

The FOL (or designee) is responsible for the care and custody of the samples collected until they are relinquished to the analyzing laboratory or entrusted to a commercial overnight courier. Chain-of-custody reports are completed for each sample shipment. The reports are filled out in a legible manner, using waterproof ink, and are signed and dated by the sampler. Pertinent notes, such as whether the sample was field filtered or whether the sample is suspected to be high in contaminant concentration, are also indicated on the chain-of-custody report. Information similar to that contained in the chain-of-custody report is also provided on the sample label, which is securely attached to the sample bottle. Chain-of-custody report forms and sample labels will be supplied by the laboratory subcontractor. In accordance with NFESC guidelines, samples for chemical constituent analysis must be sent (for next-day receipt) to the laboratory within 24 hours of collection.

Full details regarding sample chain-of-custody (including use of custody seals and sample shipment protocols) are contained in TtNUS Corporate SOP SA-6.1, which is provided as Attachment 1. TtNUS

Corporate SOP SA-6.3, also provided in Attachment 1, discusses maintenance of site logbooks, site notebooks, and other field records. All sample records are eventually docketed into the TtNUS project central file.

6.2 LABORATORY CUSTODY PROCEDURES

When samples are received by the laboratory subcontractor, the laboratory's sample custodian examines each cooler's custody seals to verify that they are intact and that the integrity of the environmental samples has been maintained. The sample custodian then signs the chain-of-custody report. The custodian then opens the cooler and measures its internal temperature. The temperature reading is noted on the accompanying chain-of-custody report. The sample custodian then examines the contents of the cooler. Sample container breakages or discrepancies between the chain-of-custody report and sample label documentation are recorded. With the exception of samples for volatile analysis, the pH of chemically preserved samples is checked using pH paper and recorded. All problems or discrepancies noted during this process are to be promptly reported to the TOM (or designee). Inter-laboratory chain-of-custody procedures and specific procedures for sample handling, storage, disbursement for analysis, and remnant disposal will be followed as specified by the subcontract laboratory's SOPs and/or QA Plan.

The laboratory will maintain a hardcopy file of all analytical data associated with this project in a secure area. Access to the data will be limited to laboratory, TtNUS, and Navy personnel. The hardcopy files will be maintained by the laboratory for a minimum of 7 years.

6.3 FINAL EVIDENCE FILES

The TtNUS central file will be the repository for all documents that constitute evidence relevant to sampling and analysis activities as described in this QAPP. TtNUS is the custodian of the evidence file and maintains the contents of these files, including all relevant records, reports, logs, field notebooks, photographs, subcontractor reports and data reviews in a secure, limited-access location and under custody of the TtNUS facility manager. The control file will include at a minimum:

- Field logbooks
- Field data and data deliverables
- Photographs
- Drawings
- Soil boring logs
- Laboratory data deliverables
- Data validation reports
- Data assessment reports

- Progress reports, QA reports, interim project reports, etc.
- All custody documentation (chain-of-custody forms, airbills, etc.)

Upon completion of the contract, all pertinent files will be relinquished to the custody of the United States Navy.

7.0 CALIBRATION PROCEDURES AND FREQUENCY

All instrumentation used to perform chemical measurements must be properly calibrated prior to use in order to obtain valid and usable results. The requirement to properly calibrate instruments prior to use applies equally to field instruments and fixed laboratory instruments.

7.1 FIELD INSTRUMENT CALIBRATION

Field instrument calibration will be conducted according to Section 16 of the USEPA EISOPQAM.

7.2 LABORATORY INSTRUMENT CALIBRATION

Calibration procedures for a specific laboratory instrument will consist of initial calibration (typically 3 to 5 calibration points) and continuing calibration verification. In all cases, the initial calibration will be verified using an independently prepared calibration verification solution. The frequency of calibration will be performed according to the requirements of the specific methods.

All standards used to calibrate analytical instruments must be obtained from the National Institute of Standards and Technology (NIST) or through a reliable commercial supplier with a proven record for quality standards. All commercially supplied standards must be traceable to NIST reference standards, where possible, and appropriate documentation will be obtained from the supplier. In cases where documentation is not available, the laboratory will analyze the standard and compare the results to a USEPA-supplied known or previous NIST-traceable standard.

The calibration procedures and frequencies used by the subcontract laboratory will comply with the applicable analytical method. Brief descriptions of calibration procedures for major instrument types follow.

For dioxin/furan compounds using Method 8290, the high resolution gas chromatograph/high resolution mass spectrometer (HRGC/HRMS) system will be tuned and calibrated in accordance with the appropriate analytical method. A PFK instrument performance check (tuning check) must be run prior to the initial calibration and each continuing calibration and must meet all method-specified criteria before analysis may continue. Initial calibration is required before any samples are analyzed and must include a blank and a minimum of five different concentrations as specified in the method. A PFK tuning check and a continuing calibration check, including the mid-range standard and a blank, must be performed at the beginning of each 12-hour period during which analyses are performed.

For dioxin/furan compound analysis using Method 4025m, a three-point calibration sample set is implemented with each sample group. The three points are selected to represent the anticipated range (without dilution). Sensitivity of the bio-assay enzymes is fixed; therefore, calibration adjustments are performed to eliminate variations in extraction efficiency rather than instrument drift/errors.

8.0 ANALYTICAL AND MEASUREMENT PROCEDURES

Samples will be subjected to field and laboratory parameter measurement as necessary based on the sample matrix and location under investigation. The analytical program for environmental samples collected at each anticipated location is provided in Section 3.0 of the VSAP.

Groundwater chemical/physical parameters to be measured using field instrumentation include temperature, specific conductance, pH, turbidity. Measurement of field parameters and calibration of field instruments are discussed in Section 16 of the USEPA EISOPQAM.

The analytical laboratory responsible for the chemical analyses will be NFESC-approved, certified by the National Environmental Laboratory Accreditation Conference (NELAC) for all analyses requested by TtNUS. Documentation of the certifications will be provided to TtNUS as described in the TtNUS analytical Statement of Work for the contracted laboratory.

All environmental samples for dioxin/furan analysis will be analyzed in accordance with current SW-846 methods. All groundwater samples for miscellaneous parameter analyses will be analyzed in accordance with current USEPA approved methods. Table 8-1 provides a summary of the laboratory analytical methods for the NCBC Gulfport Site 8 verification sampling effort.

A complete list of the target compounds/analytes and RQLs is provided in Table 1-1 of this QAPP. Data generated through use of the SW-846 method protocols will be reported to the RQL for nondetected compounds from organics analysis. Compounds that are positively identified and that can be quantitated at concentrations less than the RQL but greater than the calculated method detection limit (MDL) will be reported as specified in the appropriate analytical method.

Quantitation and detection limits will also be adjusted, as necessary, based on dilutions and sample volume.

TABLE 8-1

SUMMARY OF ANALYTICAL PROCEDURES
NCBC GULFPORT, MISSISSIPPI
SITE 8 QAPP

Analytical Parameter	Analytical Method
Dioxins/Furans	SW-846 4025m
Dioxins/Furans	SW-846 8290

9.0 PREVENTIVE MAINTENANCE PROCEDURES

Measuring equipment used in environmental monitoring or analysis for the Site 8 verification sampling shall be maintained in accordance with the manufacturer's operation and maintenance manuals. Equipment and instruments shall be calibrated in accordance with the procedures and at the frequency discussed in Section 7.0 (Calibration Procedures and Frequency). Preventive maintenance for field and laboratory equipment is discussed in the remainder of this section.

9.1 FIELD EQUIPMENT PREVENTIVE MAINTENANCE

TtNUS has established a program for the maintenance of field equipment to ensure the availability of equipment in good working order when and where it is needed. This program consists of the following elements:

- The TtNUS equipment manager keeps an inventory of the equipment in terms of items (model and serial number), quantity, and condition. Each item of equipment is signed out when in use, and its operating condition and cleanliness checked upon return.

- The equipment manager conducts routine checks on the status of equipment and is responsible for the stocking of spare parts and for equipment readiness. The equipment manager also maintains the equipment manual library.

- The FOL is responsible for working with the equipment manager to make sure that the equipment is tested, cleaned, charged, and calibrated in accordance with the manufacturer's instructions and Section 16 of the USEPA EISOPQAM before being taken to the job site and during field activities.

- During calibration, an appropriate maintenance check is performed on each piece of equipment. Any problems encountered while operating the instrument will be recorded in the field log book, including a description of the symptoms and corrective actions taken.

- If a problem with the equipment is detected or requires service, the equipment should be logged, tagged, and segregated from equipment in proper working order. Use of the instrument will not resume until the problem is resolved.

9.2 LABORATORY INSTRUMENT PREVENTIVE MAINTENANCE

Proper maintenance of laboratory instruments and equipment is essential to ensuring their readiness when needed. Dependent on manufacturer's recommendations, maintenance intervals are established for each instrument. All major instruments must be labeled with a model number and serial number, and a maintenance logbook must be maintained for each major instrument. Personnel must be alert to the maintenance status of the equipment they are using at all times.

9.2.1 Major Instruments

Table 9-1 provides a summary of preventive maintenance procedures typically performed for key analytical instruments. Maintenance of key instruments is sometimes covered under service contracts with external firms. These contracts provide for periodic routine maintenance to help guard against unexpected instrument downtime. The contracts also provide for quick response for unscheduled service calls when malfunctions are observed by the operator.

The use of manufacturer recommended grades or better of supporting supplies and reagents is also a form of preventive maintenance. For example, gases used in the various gas chromatographs and metals instruments should be of sufficient grade to minimize fouling of the instrument. The routine use of septa, chromatographic columns, ferrules, atomic adsorption furnace tubes, and other supporting supplies from reputable manufacturers will assist in averting unnecessary periods of instrument downtime.

9.2.2 Refrigerators/Ovens

The temperatures of refrigerators used for sample storage and drying ovens will be monitored a minimum of once daily. The acceptable range for refrigerator temperatures is 4°C ±2°C. Required temperatures of ovens will vary based on the analytical methods for which the ovens are used. The temperatures will be recorded on temperature logs. The logs will contain the following information at a minimum:

- Date
- Temperature
- Initials of person performing the check

Maintenance of the logs is typically the responsibility of the sample custodian. However, assignment of responsibilities for temperature monitoring to specific personnel does not preclude the participation of other laboratory personnel. If unusual temperature fluctuations are noted, it is the responsibility of the observer to immediately notify the person in charge of the discrepancy before the condition of the samples is compromised.

Unstable or fluctuating temperatures may be indicative of malfunctions in the cooling or heating system. On the other hand, the instability may be due to frequent opening of the door. Regardless of the cause, such an observation must be investigated, and modifications must be made to access procedures, or repairs to equipment must be made to prevent jeopardizing the integrity of the samples.

TABLE 9-1

TYPICAL PREVENTIVE MAINTENANCE FOR KEY ANALYTICAL INSTRUMENTS NCBC GULFPORT SITE 8 QAPP, GULFPORT, MISSISSIPPI

Instrument	Preventive Maintenance	Maintenance Frequency
GC/MS	Bake oven, replace septum, check carrier gas, clip column, clean injection port. Replace solvent washes and clean syringe.	As required. Daily.
GC	Bake oven, replace septum, check carrier gas, clip column, clean injection port. Replace solvent washes and clean syringe.	As required. Daily.
HPLC	Change filter in mixer, change column pre-filter, change pump seals. Rinse water pump with methanol, filter water, sonicate water intake filter frit.	As required. Weekly.
HRGC/HRMS	Bake oven, replace septum, check carrier gas, clip column, clean injection port. Replace solvent washes and clean syringe.	As required. Daily.
ICP	Change sample introduction tubing, clean nebulizer, clean spray chamber, clean torch, manual profile, and automatic profile optics.	As required.
CVAA	Change sample introduction tubing, change drying cell, re-zero detector.	As required
GFAA	Clean contact cylinders, replace/clean tube, check lamp alignment.	As required

10.0 INTERNAL QUALITY CONTROL CHECKS

Field-related QC checks were discussed in Section 3.0 of this QAPP. This section provides additional information regarding internal QC checks for the field and the laboratory.

10.1 FIELD QUALITY CONTROL CHECKS

QC procedures for field measurements will include calibrating the instruments as discussed in Section 16 of the USEPA EISOPQAM. Assessment of field sampling precision and bias will be made by collection of field duplicates and rinsate blanks for laboratory analysis as discussed in Section 3.6 of this QAPP.

10.2 LABORATORY QUALITY CONTROL CHECKS

The subcontract laboratory will have a QC program that ensures the reliability and validity of the analyses performed at the laboratory. Internal QC procedures for analyses will comply with the applicable analytical method requirements.

Several internal laboratory QC checks are briefly discussed in the remainder of this section.

Laboratory method blanks are prepared and analyzed in accordance with the analytical method employed to indicate whether contaminants originating from laboratory sources have been introduced and may have affected environmental sample analyses. A method blank generally consists of an aliquot of analyte-free water that is subjected to the same preparation and analysis procedures as the environmental samples undergoing analysis. With the exception of recognized volatile and semivolatile common laboratory contaminants (e.g., methylene chloride, acetone, 2-butanone, and phthalates) detected, method blanks must not contain levels of target analytes greater than the reported quantitation limits (greater than 2.5 times the RQL for methylene chloride and greater than 5 times the RQL for acetone, and 2-butanone). Under no circumstances are laboratory method blank contaminant values subtracted from environmental sample analysis results.

Matrix spike analysis for organic fraction analyses is performed in duplicate as a measure of laboratory precision. For dioxin/furan analyses, laboratory duplicates are prepared by thoroughly mixing and splitting a sample aliquot into two portions and analyzing each portion following the same analytical procedures that are used for the environmental sample analyses. The field crew provides extra volumes of sample matrices designated for laboratory quality control analyses, as required. Control limits for MS and laboratory duplicate analyses are discussed in Section 3.0 of this QAPP and are listed in Tables 3-1 through 3-4.

Surrogates are organic compounds (typically brominated, fluorinated, or isotopically labeled) that are similar in nature to the compounds of concern and that are not likely to be present in environmental media. Surrogates are spiked into each sample, standard, and method blank prior to analysis and are used only in organic chromatographic analysis procedures as a check of method effectiveness and extraction efficiency. As discussed in Section 3.0 of this QAPP, surrogate recoveries are evaluated against control limits specified in the associated method, where applicable, or laboratory-derived control limits.

LCSs monitor the overall performance of each step during the analysis, including the sample preparation. LCS analysis will be performed as required by the applicable analytical method. Aqueous LCS results must fall within the control limits specified in the analytical method, where applicable, or established by the laboratory. Aqueous LCSs shall be analyzed utilizing the same sample preparations, analytical methods, and QA/QC procedures as employed for the samples.

Internal standard performance criteria ensure that organic GC/MS and HPLC analysis sensitivity and response are stable during every analytical run. Internal standard area counts for samples and blanks must not vary by more than a factor of two (- 50 percent to + 100 percent) from the associated calibration standard. The retention time of the internal standards in samples and blanks must not vary by more than ±30 seconds from the retention time of the associated calibration standard.

11.0 DATA REDUCTION, VALIDATION, AND REPORTING

This section describes the procedures to be used for data reduction, review, and reporting for the NCBC Gulfport Site 8 verification sampling program. All data generated during the course of the investigation will be maintained in hardcopy format by TtNUS in the Naval Facilities Engineering Command Southern Division designated central files located in TtNUS' Pittsburgh, Pennsylvania office.

In addition to the central files, photocopies of all hardcopy data (as well as electronic data) will be maintained in the Chemistry/Toxicology/Risk Assessment Department database records files located in TtNUS' Pittsburgh, Pennsylvania office. Upon completion of the contract, all files will be relinquished to the Navy.

11.1 DATA REDUCTION

Data reduction will be completed for both field measurements and laboratory-generated analytical data. Field data reduction will be relatively limited compared to the degree of laboratory data reduction required for the project. Reduction of both field and laboratory data are discussed in the remainder of this section.

11.1.1 Field Data Reduction

Field data will be generated through on-site water quality testing for general indicator parameters including pH, specific conductance, turbidity, temperature.

The field parameters will be recorded in the site logbook or on sample logsheets immediately after the measurements are taken and later encoded in the NCBC Gulfport database. If an error is made in the logbook, the error will be legibly crossed out (single-line strikeout), initialed and dated by the field member, and corrected in a space adjacent to the original (erroneous) entry. No calculations will be necessary to reduce these data. Field data will be entered in the electronic database manually, and the entries will be verified by an independent reviewer to make sure that no "transcription" errors occurred.

Field measurements will be recorded and reported in the following units:

- Hydronium ion concentration in standard pH units.
- Temperature in degrees Celsius.
- Specific Conductance in uMhos/cm.
- Turbidity in Nephelometric turbidity units (NTUs).

Standard pH units as specified above are the negative logarithm (base 10) of the hydronium ion concentration in moles/liter.

11.1.2 Laboratory Data Reduction

Laboratory analytical data will be reported using standard concentration units to ensure comparability with regulatory standards/guidelines and previous analytical results. Reporting units for aqueous matrices for the classes of chemicals under consideration are as follows:

Groundwater samples:

- Dioxins/furans – pg/L

Soil and Sediment Samples:

- Dioxins/furans – ng/kg

Field QC sample results will be included in the database for the NCBC Gulfport Site 8 verification sampling program. Specifically, the analytical results for field duplicates and rinsate blanks will be provided. The results for field QC samples will be considered during the course of data review (in concert with laboratory method blanks) to eliminate false positive results according to the 5- and 10-times rules specified in the National Functional Guidelines for Organic Review. The results for laboratory QC samples such as method blanks will not be presented in the database. In addition, only the original (unspiked) sample results for MS/MSD samples will be provided in the database.

11.2 DATA VALIDATION

Validation of field measurements and laboratory analytical data are discussed in this section. Validation of field data will be limited to real-time checks as discussed in Section 11.2.1. Laboratory analytical data will be reviewed against data validation rules as discussed in Section 11.2.2.

11.2.1 Field Measurement Data Validation

Field measurements will not be subjected to a formal data validation process. However, field technicians will ensure that the equipment used for field measurement is performing accurately via calibration as discussed in Section 16 of the USEPA EISOPQAM. The FOL will ensure that the field tests are performed in accordance with the test manufacturer's instructions and that the field meters are used in accordance with the instrument manufacturer's instructions. The results of field tests and measurements will be recorded in field logbooks or sample logsheets. This information will be reviewed by the FOL to verify the information was recorded properly (i.e., no transcription errors) and the proper field analyses were performed. As described in Section 11.1.1, all field data entered into the electronic database will be independently reviewed for transcription errors. A comparison will be made of samples collected relative to samples planned for collection to ensure that all intended samples have been collected.

11.2.2 Laboratory Data Review

One hundred percent of the laboratory data will undergo a full data validation. A full data validation evaluates items including, but not limited to the following: sample holding times, method blank analyses, initial and continuing calibration standards, data completeness, reported detection limits, LCS analysis, MS/MSD analysis, and duplicate sample analyses. Review of analytical data will be completed by the TtNUS Chemistry Department located in TtNUS' Pittsburgh, Pennsylvania office. Final review and approval of reviewed deliverables will be completed by the Department's Data Validation Manager. The TOM will maintain contact with the Data Validation Manager to ensure that management of the acquired data proceeds in an organized and expeditious manner.

Organic data analytical results will be reviewed versus the applicable analytical method. Data will be accepted, rejected, or qualified based on the results of the limited review items. Guidelines established in the USEPA National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (August 2002) and the NFESC Navy Installation Restoration Chemical Data Quality Manual (September 1999) will be used as guidance to define the criteria for the full data validation items.

11.3 DATA REPORTING

11.3.1 Field Measurement Data Reporting

Field data will be reported in the units discussed in Section 11.1.1. The report will include a comprehensive database including all field measurements. Field measurements will be transferred from the site logbook or sample logsheets to the electronic database manually and will be reviewed for accuracy by an independent reviewer. Transcription of field measurements to the electronic database will be completed shortly after completion of the field investigation and prior to receipt of laboratory analytical data.

All records regarding field measurements (i.e., field logbooks, sampling logbooks, and sample logsheets) will be placed in TtNUS' Southern Division central files upon completion of the field effort. Entry of these results in the database will require removal of these results from the files. Outcards will be used to document the removal of any such documentation from the files. Outcards will include the date of document removal, the name of the person using the document, and the title of the document removed. Field measurement data will be reported in an appendix to the report, at a minimum, and may also be reported in summary fashion if they are indicative of the presence of contamination (e.g., high specific conductance readings).

11.3.2 Laboratory Data Reporting

Data reported by the laboratory will be in accordance with the reporting format described in TtNUS' analytical Statement of Work for the contracted laboratory. All pertinent QC data including method blanks, standards analysis, calibration information, etc. will be provided for the non-SW-846 method analyses. Case narratives and a certificate of analysis will be provided for each Sample Delivery Group (SDG).

All environmental and field QC sample results (field duplicates and rinsate blanks) will be included in the report as an appendix. The database will include pertinent sampling information such as sample number, sampling date, general location, depth, and survey coordinates (if applicable). Sample-specific detection limits will be reported for nondetected analytes. Units will be clearly summarized in the database and will conform to those identified in Section 11.1.2. The analytical data may also be reported in summary fashion within the body of the report text in tabular and graphic fashion.

Data will be handled electronically pursuant to the electronic deliverable requirements specified in TtNUS' purchase order with analytical laboratories. This agreement requires the analytical laboratories to provide data in both hardcopy and electronic form. The laboratory will provide a 28-calendar-day turnaround time for the delivery of the SDG in both hardcopy and electronic format. The original electronic diskettes and the original hardcopy analytical data are maintained in TtNUS' Southern Division central files as received.

Data review will be completed using the hard copy data. Upon completion of the review of a SDG and review by the Data Validation Manager, review qualifiers will be entered in the electronic database and will be subjected to independent review for accuracy. During this review process, the electronic database printout will also be contrasted with the hard copy data to ensure that the hard copy data and electronic data are consistent.

In addition, a summary of the data qualifiers for all project samples will be prepared. This summary will include a list of chemicals identified as laboratory and/or field QC blank contaminants, holding time exceedences, samples exhibiting field duplicate/replicate imprecision as well as affected chemicals, rejected results and associated specific causes, and general causes of estimated results. This summary will facilitate the preparation of a summary of the data review results and completeness assessment for inclusion in the report.

12.0 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY, COMPLETENESS, FIELD DUPLICATES, AND DATA USABILITY

Compliance with the QC objectives outlined in Section 3.0 will be monitored via two separate mechanisms. Precision and accuracy will be assessed through data, while compliance with the completeness objectives for field and laboratory data/measurement will be calculated by hand (field measurements) and electronically via a database subroutine (laboratory data). Information necessary to complete the precision and accuracy calculations will be provided in electronic and hardcopy form by the subcontract laboratory. Equations to be used for the precision, accuracy, and completeness assessment are outlined in the remainder of this section.

12.1 ACCURACY ASSESSMENT

To assure the accuracy of the analytical procedures, a minimum of one of every 20 samples is spiked with a known amount of the analyte or analytes to be evaluated. The spiked sample is then analyzed. The increase in concentration of the analyte observed in the spiked sample, because of the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines the %R. Control charts are plotted for each commonly analyzed compound and kept on matrix-specific and analyte-specific bases. The %R for a spiked sample is calculated according to the following formula:

$$\%R = \frac{\text{Amount in Spiked Sample} - \text{Amount in Sample}}{\text{Known Amount Added}} \text{ X } 100\,\%$$

12.2 PRECISION ASSESSMENT

Duplicate and MS/MSD samples are prepared and analyzed at a minimum frequency of one per 20 environmental samples. Duplicate samples are provided by the field crew.

MS/MSD samples are prepared by spiking each of the aliquots with a known amount of analyte. The duplicate samples are handled in the same manner as the other environmental samples included in the analytical sample set. The RPD between the sample (or MS) and duplicate sample (or MSD) is calculated and plotted. The RPD is calculated according to the following formula:

$$RPD = \frac{\text{Amount in Sample} - \text{Amount in Duplicate}}{0.5\,(\text{Amount in Sample} + \text{Amount in Duplicate})} \text{ X } 100\,\%$$

12.3 COMPLETENESS ASSESSMENT

Completeness is the ratio of the number of valid sample results to the total number of sample results expected to be obtained for the project as a whole. Following the completion of the analytical testing and data validation, the percent completeness will be calculated by the following equation:

$$\text{Completeness} = \frac{\text{(number of valid measurements)}}{\text{(number of measurements planned)}} \times 100\,\%$$

The results of the data validation process and the completeness assessment will be summarized in the report using the summary format discussed in Section 11.3.2 and an electronic database subroutine.

12.4 FIELD DUPLICATE ASSESSMENT

Field duplicate sample results and their associated sample results will be assessed using the calculated average of the two results when performing risk and ecological assessments.

$$\text{Average} = \text{(sample result + duplicate result)} \times 0.5$$

12.5 DATA USABILITY ASSESSMENT

Data validation, accuracy, precision, completeness, and duplicate assessments are completed with regards to specific criteria. The results of the validation and assessments are applied to project-specific standards that determine the usability of the data. The impact of any rejected data must be addressed to determine if the overall project objective has been compromised. This section details the technical criteria on which the validation and assessments are based, the project-specific standards applied to the "qualified data", and the impact of rejected data on the overall project objective.

Technical Criteria

Accuracy, precision, and duplicate assessments (the calculations are detailed in Sections 12.1, 12.2, and 12.4, respectively) are based on the technical criteria listed in Section 3 of this QAPP. A completeness assessment if also performed. The data must be a 95 percent complete (the calculation is detailed in Section 12.3) to fulfill the completeness standard as stated in Section 3.3 of this QAPP. Guidelines established in the USEPA National Functional Guidelines for Chlorinated Dioxin/Furan Data Review (August 2002) and the NFESC Navy Installation Restoration Chemical Data Quality Manual (September 1999) will be used as guidances to define the criteria for the data validation. The results of the assessments and the validation provide the data user with "qualified data".

Standards

Project-specific standards addressed in this section are used to determine the usability of the qualified data. The following list details the standards to be used when determining the usability of the data:

- Any data collected using procedures not specified in the VSAP and without prior approval from the TOM will be rejected.

- If the completeness assessment returns a value of less than 95 percent complete, all data will be rejected.

- Any data point rejected during the data validation or assessments will not be used.

- If a data point is qualified as estimated during the validation or assessments the following tests will be implemented:

  1. Will the qualified result affect any decisions for the project or site?
     - No – then the result is rejected and not included.
     - Yes – continue to Test #2.
  2. Could the result be biased high?
     - No – continue to Test #3.
     - Yes – continue to Test #4.
  3. Could the result be biased low?
     - No – then the result is accepted and included.
     - Yes – continue to Test #4.
  4. If the result is biased high or low, how will the result affect the decisions for the project or site?
     - If a biased high contamination result will result in the exceedence of MCLs, the result will be rejected and the original sample location will be resampled.
     - If a biased high contamination result will result in no exceedence of MCLs, the result will be accepted and included.
     - If a biased low contamination result will result in no exceedence of MCLs, the result will be rejected and the original sample location will be resampled.
     - If a biased low contamination result will result in the exceedence of MCLs, the result will be accepted and included.

- For any 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) result that is classified as an estimated maximum possible concentration (EMPC), the result will either be reported as a positive detection or the original sample location will be resampled and the new TCDD result will be accepted as the new sample result.

- For a dioxin or furan congener other than TCDD that is classified as an EMPC, the result will be reported as a non-detected value.

Using these standards to determine the usability of the data will ensure that the integrity of the project objective is maintained. Maintaining the project objective will ensure accurate decisions are made when determining the most appropriate action for the project or site. Rejected data must be considered to determine its impact on project decisions.

Rejected Data

Rejected data can have significant impact on the decisions that will determine the status of the project or site. Specific questions about the rejected data must be addressed and answered before making any final decisions. Question to be addressed about rejected data is:

Is it possible that MCLs will not be exceeded when the rejected data is not included?

- Yes – Additional data will be collected to determine if non-rejected data will or will not exceed MCLs.
- No – Additional data will not be collected. Final decisions will be made without the rejected data.

Answers to this question will determine if and how the project objective will be met.

Using technical criteria to determined the validity of the collected data, project-specific standards to determine the usability of the qualified data, and determining the impact of rejected data on project objectives will ensure that quality data and informed decisions are made with respect to the project objective and future studies at the site.

13.0 PERFORMANCE AND SYSTEM AUDITS

Performance and system audits will be performed periodically to ensure that work is being implemented in accordance with the approved project plans and in an overall satisfactory manner. Such audits will be performed by various personnel and will include evaluation of field, laboratory, data review, and data reporting processes. Examples of pertinent audits are as follows:

- The FOL will supervise and check daily that the field measurements are made accurately, equipment is thoroughly decontaminated, samples are collected and handled properly, and fieldwork is documented accurately and neatly.

- Performance and system audits of the laboratory will be performed regularly (every 18 months) by a Navy Contractor (internal) and in accordance with the Laboratory Quality Assurance Plan (internal).

- Data reviewers will evaluate (on a timely basis) the chemical analytical data packages submitted by the laboratory. The data reviewers will check that the data were obtained through use of an approved methodology, that the appropriate level of QC effort and reporting was conducted, and whether or not the results are in conformance with QC criteria. Based on these factors, the data reviewer will generate a report describing data limitations, which will be reviewed internally by the Data Validation Manager prior to submittal to the TOM.

- A formal audit of the field sampling procedures may be conducted by the TtNUS QAM or designee in addition to the auditing that is an inherent part of the daily project activities. The purpose of this audit is to ensure that sample collection, handling, and shipping protocols and equipment decontamination and field documentation procedures are being performed in accordance with the approved project plans and SOPs. An audit will be performed if the TtNUS TOM, TtNUS QAM, Navy Remedial Project Manager, or USEPA or MDEQ Regulator develops concerns with regards to the field sampling effort.

14.0 CORRECTIVE ACTION

Under TtNUS' QA/QC program, it is required that any and all personnel noting conditions adverse to quality report these conditions immediately to the TOM and the QAO. These parties, in turn, are charged with performing root-cause analyses and implementing appropriate corrective action in a timely manner. It is ultimately the responsibility of the QAO to document all findings and corrective actions taken and to monitor the effectiveness of the corrective measures performed.

14.1 FIELD CORRECTIVE ACTION

Field nonconformances or conditions adverse to quality must be identified and corrected as quickly as possible so that work integrity or quality of product is not compromised. The need for corrective action may arise based on deviations from project plans and procedures, adverse field conditions, or other unforeseen circumstances. Corrective action needs may become apparent during the performance of daily work tasks or as a consequence of internal or external field audits.

Corrective action may include resampling and may involve amending previously approved field procedures. If warranted by the severity of the problem (e.g., if a change in the approved project plan documents or SOPs is required), the Navy will be notified in writing via a Field Task Modification Request (FTMR), and Navy (in conjunction with USEPA Region IV) approvals will be obtained. The FOL is responsible for initiating FTMRs; an FTMR will be initiated for all deviations from the project plan documents, as applicable. An example of an FTMR is provided as Figure 14-1. Copies of all FTMRs will be maintained with the on-site project planning documents and will be placed in the final evidence file.

Minor modifications to field activities such as a slight offset of a boring location will be initiated at the discretion of the FOL, subject to on-site approval by NCBC Gulfport personnel. Approval for major modifications (e.g., elimination of a sampling point) must be obtained via an FTMR.

14.2 LABORATORY CORRECTIVE ACTION

In general, laboratory corrective actions are warranted whenever an out-of-control event or potential out-of-control event is noted. The specific corrective action taken depends on the specific analysis and the nature of the event. Generally, the following occurrences alert laboratory personnel that corrective action may be necessary:

- QC data are outside established warning or control limits.
- Method blank analyses yield concentrations of target analytes greater than acceptable levels.

- Undesirable trends are detected in spike recoveries or in duplicate RPDs.
- There is an unexplained change in compound detection capability.
- Inquiries concerning data quality are received.
- Deficiencies are detected by laboratory QA staff audits or from performance evaluation sample test results.

Corrective actions are typically documented for out-of-control situations on a corrective action form. Using a corrective action form, any employee may notify the QAO of a problem. The QAO generally initiates the corrective action by relating the problem to the appropriate Laboratory Manager and/or Internal Coordinator who then investigates or assigns responsibility for investigating the problem and its cause. After an appropriate corrective action is determined, it is approved by the QAO. Its implementation is verified and documented on the corrective action form and is further documented through audits.

14.3 CORRECTIVE ACTION DURING DATA REVIEW AND DATA ASSESSMENT

The need for corrective action may become apparent during data review and assessment. Data is sometimes qualified or rejected due to deviances from project SOPs or project-specific control limits. Section 12.5 details the technical criteria and project-specific standards used when determining the usability of the data. The impact of rejected data and corrective actions to be used when data is rejected is also discussed in Section 12.5. The performance of rework or, instituting a change in work procedures are possible corrective actions relevant to data evaluation activities. The TOM will be responsible for approving the implementation of corrective action.

FIGURE 14-1

TETRA TECH NUS, INC.
FIELD TASK MODIFICATION REQUEST FORM

____________________	____________________	____________________
Client Identification	Project Number	FTMR Number

To______________________________ Location____________________ Date____________________

Description:

____
____
____
____

Reason for Change:

____
____
____
____

Recommended Disposition:

____
____
____
____

____
Field Operations Leader (Signature, if applicable) Date

Disposition:

____
____
____
____

____
Task Order Manager (Signature, if required) Date

____
Distribution:

Program Manager	Others as required____________________
Quality Assurance Officer	____________________
Task Order Manager	____________________
Field Operations Leader	____________________

15.0 QUALITY ASSURANCE REPORTS TO MANAGEMENT

QA reports to management will be provided in three primary formats during the course of the NCBC Gulfport Site 8 verification sampling program. Data review letter reports will be prepared on a SDG-specific basis and will summarize QA issues for the subcontract laboratory data. In addition, written weekly reports summarizing accomplishments and QA/QC issues during the field investigation will be provided by the FOL. Finally, monthly progress reports are provided by the TOM. In addition, a summary of data review qualifiers and a completeness assessment for all project samples will be prepared.

15.1 CONTENTS OF PROJECT QUALITY ASSURANCE REPORTS

The contents of the specific QA reports are as follows. The data review reports address major and minor laboratory noncompliances as well as noted sample matrix effects. In the event that major problems occur with the analytical laboratory (e.g., holding time exceedences or calibration noncompliances, etc.) the Data Validation Manager will notify the TOM and the Laboratory Services Coordinator. Such notifications (if necessary) are typically provided via internal memoranda and are placed in the project file. Such reports contain a summary of the noncompliance, a synopsis of the impact on individual projects, and recommendations regarding corrective action and compensational adjustments. Corrective actions are initiated at the program level.

The FOL will provide the TOM with weekly reports regarding accomplishments, deviations from the VSAP, upcoming activities, and a QA summary during the course of the field investigation. In addition, monthly project review meetings are held for all active Navy CLEAN III projects. Issues discussed at the project review meeting include all aspects of budget and schedule compliance and QA/QC problems. The TOM provides a monthly progress report to the Navy, which addresses the project budget, schedule, accomplishments, planned activities, required revisions of the QAPP, and QA/QC issues and intended corrective actions.

15.2 INDIVIDUALS RECEIVING/REVIEWING QUALITY ASSURANCE REPORTS

Data review QA Reports are provided to the TOM for inclusion in the project files. In the event that major problems are observed for a given laboratory, the Program Manager, Deputy Program Manager, QAM, TOM, QAO, and Laboratory Services Coordinator are provided with copies of the QA report. Weekly field progress reports are provided to the TOM. Monthly progress reports are provided to the Navy CLEAN III Program Manager and the Navy CLEAN III Contracting Officer's Technical Representative.

ATTACHMENT 1

TTNUS STANDARD OPERATING PROCEDURES

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide information on sample preservation, packaging, and shipping procedures to be used in handling environmental samples submitted for chemical constituent, biological, or geotechnical analysis. Sample chain-of-custody procedures and other aspects of field documentation are addressed in SOP SA-6.3. Sample identification is addressed in SOP CT-04.

2.0 SCOPE

This procedure:

- Describes the appropriate containers to be used for samples depending on the analyses to be performed, and the steps necessary to preserve the samples when shipped off site for chemical analysis.
- Provides instruction for sample packaging and shipping in accordance with current U.S. Department of Transportation (DOT) and International Air Transportation Association (IATA) regulations. IATA regulates transportation of hazardous materials by air (which is the mode of transportation used for shipping nearly all samples derived during TtNUS projects).

3.0 GLOSSARY

Hazardous Material - A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce, and which has been so designated. Under 49 CFR, the term includes hazardous substances, hazardous wastes, marine pollutants, and elevated temperature materials, as well as materials designated as hazardous under the provisions of §172.101 and §172.102 and materials that meet the defining criteria for hazard classes and divisions in Part 173. With slight modifications, IATA has adopted DOT "hazardous materials" as IATA "Dangerous Goods."

Hazardous Waste - Any substance listed in 40 CFR, Subpart D (ӿ261.30 et seq.), or otherwise characterized as ignitable, corrosive, reactive, or toxic (as defined by Toxicity Characteristic Leaching Procedure, TCLP, analysis) as specified under 40 CFR, Subpart C (ӿ261.20 et seq.), that would be subject to manifest requirements specified in 40 CFR 262. Such substances are defined and regulated by EPA.

Marking - A descriptive name, identification number, instructions, cautions, weight, specification or UN marks, or combination thereof required on outer packaging of hazardous materials.

n.o.i - Not otherwise indicated (may be used interchangeably with n.o.s.).

n.o.s. - Not otherwise specified.

ORM - Other regulated material (see DOT 49 CFR 173.144).

Packaging - A receptacle and any other components or materials necessary for compliance with the minimum packaging requirements of 49 CFR 174, including containers (other than freight containers or overpacks), portable tanks, cargo tanks, tank cars, and multi-unit tank-car tanks to perform a containment function in conformance with the minimum packaging requirements of 49 CFR 173.24(a) & (b).

Placard - Color-coded, pictorial sign which depicts the hazard class symbol and name and which is placed on the side of a vehicle transporting certain hazardous materials.

Common Preservatives:

- Hydrochloric Acid - HCl
- Sulfuric Acid - H_2SO_4
- Nitric Acid - HNO_3
- Sodium Hydroxide - NaOH

Other Preservatives

- Zinc Acetate
- Sodium Thiosulfate - $Na_2S_2O_3$

Normality (N) - Concentration of a solution expressed as equivalent per liter, an equivalent being the amount of a substance containing 1 gram-atom of replaceable hydrogen or its equivalent.

Reportable Quantity (RQ) - For the purposes of this SOP, means the quantity specified in column 3 of the Appendix to DOT 49 CFR §172.101 for any material identified in column 1 of the appendix. A spill greater than the amount specified must be reported to the National Response Center.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the location and time of collection.

4.0 RESPONSIBILITIES

Field Operations Leader - Directly responsible for the bottling, preservation, labeling, packaging, shipping, and custody of samples up to and including release to the shipper.

Field Samplers - Responsible for initiating the Chain-of-Custody Record (per SOP SA-6.3), implementing the packaging and shipping requirements, and maintaining custody of samples until they are relinquished to another custodian or to the shipper.

5.0 PROCEDURES

Sample identification, labeling, documentation, and chain-of-custody are addressed by SOP SA-6.3.

5.1 Sample Containers

Different types of chemicals react differently with sample containers made of various materials. For example, trace metals adsorb more strongly to glass than to plastic, whereas many organic chemicals may dissolve various types of plastic containers. Attachments A and B show proper containers (as well as other information) per 40 CFR 136. In general, the sample container shall allow approximately 5-10 percent air space ("ullage") to allow for expansion/vaporization if the sample warms during transport. However, for collection of volatile organic compounds, head space shall be omitted. The analytical laboratory will generally provide certified-clean containers for samples to be analyzed for chemical constituents. Shelby tubes or other sample containers are generally provided by the driller for samples requiring geotechnical analysis. Sufficient lead time shall be allowed for a delivery of sample container orders. Therefore, it is critical to use the correct container to maintain the integrity of the sample prior to analysis.

Once opened, the container must be used at once for storage of a particular sample. Unused but opened containers are to be considered contaminated and must be discarded. Because of the potential for introduction of contamination, they cannot be reclosed and saved for later use. Likewise, any unused containers which appear contaminated upon receipt, or which are found to have loose caps or a missing Teflon liner (if required for the container), shall be discarded.

5.2 Sample Preservation

Many water and soil samples are unstable and therefore require preservation to prevent changes in either the concentration or the physical condition of the constituent(s) requiring analysis. Although complete and irreversible preservation of samples is not possible, preservation does retard the chemical and biological changes that inevitably take place after the sample is collected. Preservation techniques are usually limited to pH control, chemical addition(s), and refrigeration/ freezing (certain biological samples only).

5.2.1 Overview

The preservation techniques to be used for various analytes are listed in Attachments A and B. Reagents required for sample preservation will either be added to the sample containers by the laboratory prior to their shipment to the field or be added in the field (in a clean environment). Only high purity reagents shall be used for preservation. In general, aqueous samples of low-concentration organics (or soil samples of low- or medium-concentration organics) are cooled to 4°C. Medium-concentration aqueous samples, high-hazard organic samples, and some gas samples are typically not preserved. Low-concentration aqueous samples for metals are acidified with HNO_3, whereas medium-concentration and high-hazard aqueous metal samples are not preserved. Low- or medium-concentration soil samples for metals are cooled to 4°C, whereas high-hazard samples are not cooled.

The following subsections describe the procedures for preparing and adding chemical preservatives. Attachments A and B indicate the specific analytes which require these preservatives.

5.2.2 Preparation and Addition of Reagents

Addition of the following acids or bases may be specified for sample preservation; these reagents shall be analytical reagent (AR) grade or purer and shall be diluted to the required concentration with deionized water before field sampling commences. To avoid uncontrolled reactions, be sure to Add Acid to water (not vice versa). A dilutions guide is provided below.

Acid/Base	Dilution	Concentration	Estimated Amount Required for Preservation
Hydrochloric Acid (HCl)	1 part concentrated HCl: 1 part double-distilled, deionized water	6N	5-10 mL
Sulfuric Acid (H_2SO_4)	1 part concentrated H_2SO_4: 1 part double-distilled, deionized water	18N	2 - 5 mL
Nitric Acid (HNO_3)	Undiluted concentrated HNO_3	16N	2 - 5 mL
Sodium Hydroxide (NaOH)	400 grams solid NaOH dissolved in 870 mL double-distilled, deionized water; yields 1 liter of solution	10N	2 mL

The amounts required for preservation shown in the above table assumes proper preparation of the preservative and addition of the preservative to one liter of aqueous sample. This assumes that the sample is initially at pH 7, is poorly buffered, and does not contain particulate matter; as these conditions vary, more preservative may be required. Consequently, the final sample pH must be checked using narrow-range pH paper, as described in the generalized procedure detailed below:

- Pour off 5-10 mL of sample into a dedicated, clean container. Use some of this sample to check the initial sample pH using wide range (0-14) pH paper. Never dip the pH paper into the sample; always apply a drop of sample to the pH paper using a clean stirring rod or pipette.

- Add about one-half of the estimated preservative required to the original sample bottle. Cap and invert gently several times to mix. Check pH (as described above) using medium range pH paper (pH 0-6 or pH 7.5-14, as applicable).

- Cap sample bottle and seal securely.

Additional considerations are discussed below:

- To test if ascorbic acid must be used to remove oxidizing agents present in the sample before it can be properly preserved, place a drop of sample on KI-starch paper. A blue color indicates the need for ascorbic acid addition.

  If required, add a few crystals of ascorbic acid to the sample and retest with the KI-starch paper. Repeat until a drop of sample produces no color on the KI-starch paper. Then add an additional 0.6 grams of ascorbic acid per each liter of sample volume.

  Continue with proper base preservation of the sample as described above.

- Samples for sulfide analysis must be treated by the addition of 4 drops (0.2 mL) of 2N zinc acetate solution per 100 ml of sample.

  The 2N zinc acetate solution is made by dissolving 220 grams of zinc acetate in 870 mL of double-distilled, deionized water to make 1 liter of solution.

  The sample pH is then raised to 9 using the NaOH preservative.

- Sodium thiosulfate must be added to remove residual chlorine from a sample. To test the sample for residual chlorine use a field test kit specially made for this purpose.

  If residual chlorine is present, add 0.08 grams of sodium thiosulfate per liter of sample to remove the residual chlorine.

  Continue with proper acidification of the sample as described above.

For biological samples, 10% buffered formalin or isopropanol may also be required for preservation. Questions regarding preservation requirements should be resolved through communication with the laboratory <u>before</u> sampling begins.

5.3 <u>Field Filtration</u>

At times, field-filtration may be required to provide for the analysis of dissolved chemical constituents. Field-filtration must be performed <u>prior to</u> the preservation of samples as described above. General procedures for field filtration are described below:

- The sample shall be filtered through a non-metallic, 0.45-micron membrane filter, immediately after collection. The filtration system shall consist of dedicated filter canister, dedicated tubing, and a peristaltic pump with pressure or vacuum pumping squeeze action (since the sample is filtered by mechanical peristalsis, the sample travels only through the tubing).

- To perform filtration, thread the tubing through the peristaltic pump head. Attach the filter canister to the discharge end of the silicon tubing (note flow direction arrow); attach the aqueous sample container to the intake end of the silicon tubing. Turn the peristaltic pump on and perform filtration. Run approximately 100 ml of sample through the filter prior to sample collection.

- Continue by preserving the filtrate (contained in the filter canister), as applicable and generally described above.

5.4 Sample Packaging and Shipping

Samples collected for shipment from a site shall be classified as either environmental or hazardous material samples. Samples from drums containing materials other than Investigative Derived Waste (IDW) and samples obtained from waste piles or bulk storage tanks are generally shipped as hazardous materials. A distinction must be made between the two types of samples in order to:

- Determine appropriate procedures for transportation of samples (if there is any doubt, a sample shall be considered hazardous and shipped accordingly.)

- Protect the health and safety of transport and laboratory personnel receiving the samples (special precautions are used by the shipper and at laboratories when hazardous materials are received.)

Detailed procedures for packaging environmental and hazardous material samples are outlined in the remainder of this section.

5.4.1 Environmental Samples

Environmental samples are packaged as follows:

- Place properly identified sample container, with lid securely fastened, in a plastic bag (e.g. Ziploc baggie), and seal the bag.

- Place sample in a cooler constructed of sturdy material which has been lined with a large, plastic (e.g. "garbage" bag). Drain plugs on coolers must be taped shut.

- Pack with enough noncombustible, absorbent, cushioning materials such as vermiculite (shoulders of bottles must be iced if required) to minimize the possibility of the container breaking.

- If cooling is required (see Attachments A and B), double-bag ice in Ziploc baggies and place around sample container shoulders, and on top of absorbent packing material (minimum of 8 pounds of ice for a medium-size cooler).

- Seal (i.e., tape or tie top in knot) large liner bag.

- The original (top, signed copy) and extra carbonless copies of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment.

- Close and seal outside of cooler as described in SOP SA-6.3. Signed custody seals must be used.

Coolers must be marked as containing "Environmental Samples." The appropriate side of the container must be marked "This End Up" and arrows placed appropriately. No DOT marking or labeling is required; there are no DOT restrictions on mode of transportation.

5.4.2 Hazardous Material Samples

Samples not determined to be environmental samples, or samples known or expected to contain hazardous materials, must be considered hazardous material samples and transported according to the requirements listed below.

NOTE: Packaging and shipping of hazardous materials can only be performed by personnel who have participated in the TtNUS training course "Shipping Hazardous Materials" (or equivalent training approved by Health Sciences).

5.4.2.1 Known Substances

If the substance in the sample is known or can be identified, package, mark, label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table (49 CFR 172.101) or the IATA List of Dangerous Goods Table (IATA Dangerous Goods Regulations). DOT Guide for shippers can be found in Attachment D of this document.

To determine the proper shipping name, use the following steps to help locate the shipping name on the Hazardous Materials Table, DOT 49 CFR 172.101.

1. Look first for the chemical or technical name of the material, for example, ethyl alcohol. Note that many chemicals have more than one technical name, for example, perchloroethylene (not listed in 172.101) is listed as tetrachloroethylene (listed 172.101). It may be useful to consult Health Sciences or a chemist for all possible technical names a material can have. If your material is not listed by its technical name, then . . .

2. Look for the chemical family name. For example, pentyl alcohol is not listed but the chemical family name is: alcohol, n.o.s. (not otherwise specified). If the chemical family name is not listed, then . . .

3. Look for a generic name based on end use. For example, Paint, n.o.s. If a generic name based on end use is not listed, then . . .

4. Look for a generic family name based on end use, for example, drugs, n.o.s. or cosmetics, n.o.s. Finally, if your material is not listed by a generic family name but you suspect or know the material is hazardous because it meets the definition of one or more hazardous classes, then . . .

5. You will have to use the general hazard class for a proper shipping name. For example, Flammable Liquid, n.o.s, or Oxidizer, n.o.s.

If you have any doubt regarding the proper shipping name, contact Health Sciences in Pittsburgh, Pennsylvania for assistance.

5.4.2.2 Unknown Substances

For samples of hazardous substances that are not listed on the Hazardous Materials Table, or are of unknown content, the shipper is required to:

1. Determine that the substance is not forbidden for shipment. Items forbidden include explosives (solid and liquid), substances liable to produce a dangerous evolution of heat or gas, and listed "unusual" compounds (which TtNUS fortunately does not typically handle). If the substance is in any way atypical of routine shipments, contact Health Sciences for further information on determining if the substance is forbidden.

2. Classify the substance by assessing whether it is anticipated to exhibit any unusual physical properties as defined by DOT (flammability, explosivity, etc.). If the substance has more than one hazard, follow the hazardous materials classification scheme identified in Attachment C of this SOP.

3. Use the generic or "n.o.s." proper shipping name that most accurately describes the article or substance. There are two types of general proper shipping names:

   - Generic, e.g., Alcohols, n.o.s. *
   - Hazard description, e.g., Flammable liquid, n.o.s.*

   Generic or n.o.s. proper shipping names marked with an "*" require the addition of the technical name in parenthesis () immediately following the proper shipping name. For example, most of our instrument calibration gases are not listed by name and must be declared under the most accurately descriptive name, which is "Compressed Gas, n.o.s. (Mixture Nitrogen and Oxygen)".

The correct shipping classification for an unknown sample is therefore selected through a process of elimination as described above (and detailed in 49 CFR 172.101(c)(11). By using the provisions in this paragraph, the proper shipping name and description will be determined. A step-by-step guide is provided by the DOT and can be found in Attachment D of this SOP. Again, if you have any doubt regarding the proper shipping name, contact Health Sciences for assistance.

5.4.3 Packaging and Shipping of Samples Classified as Flammable Liquid (or Solid)

5.4.3.1 Packaging

Applying the word "flammable" to a sample does not necessarily mean that it is in fact flammable. The word prescribes the class of packaging according to DOT regulations and classification schemes. The DOT defines flammable liquids as substances with a flash point less than 140°F (60°C). For shipping purposes, liquids with a flash point exceeding 95°F (35°C) need not be considered as flammable liquids if they are miscible solutions and have a water content of more than 90% by weight. For solutions classified as flammable liquids:

1. Containerize sample as required (see Attachments A and B). To prevent leakage, fill container no more than 90 percent full. Seal lid with teflon tape or wire.

2. Complete sample label and attach securely to sample container.

3. Seal container and place in 2-mil-thick (or thicker) polyethylene bag (e.g., Ziploc baggie), one sample per bag. Position sample identification label so that it can be read through bag. Seal bag.

4. For soil jars, place sealed bag inside metal can (available from laboratory or laboratory supplier) and cushion it with enough noncombustible, absorbent material (for example, vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other positive means to hold can lid securely, tightly and permanently. Mark can as indicated in Paragraph 1 of Section 5.3.4.2, below. Single 1-gallon bottles do not need to be placed in metal cans.

5. Place one or more metal cans (or a single 1-gallon bottle) into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans (or bottle) with noncombustible, absorbent cushioning materials for stability during transport. The absorbent material should be able to absorb the entire contents of the container. Mark container as indicated in Paragraph 2 below.

5.4.3.2 Marking/Labeling

1. Use abbreviations only where specified. Place the following information, either hand-printed or in label form, on the metal can (or 1-gallon bottle):

   - Laboratory name and address.
   - Proper shipping name from the hazardous materials table (DOT Regulation CFR 49 172.101). Example: "Flammable Liquid, n.o.s. (with the technical name in parentheses).

2. Determine packing group. The packing group must be included on the shipping papers in the description section. Packaging groups are classified as follows:

   Group I. Most Hazardous
   Group II. Medium Hazard
   Group III. Least Hazardous

   The packing group will be listed in the hazardous materials table, column 5.

3. Place the following information on outside shipping container per the instructions provided in the "Shipping Hazardous Materials" course:

   - Proper shipping name
   - UN or NA number
   - Proper label(s)
   - Addressee and sender

For flammable liquids, the following are the proper labels to be placed on the outside shipping container:

- DOT "Flammable liquid" label
- Package orientation label (arrows pointing upward) on at least two opposite sides of the package
- "Cargo Aircraft Only" label if shipping more than 30L of flammable liquids in the package.

5.4.3.3 Shipping Papers

Principally because of limitations in sample holding times, TtNUS almost exclusively uses air transportation to ship hazardous materials and other environmental samples. The "Dangerous Goods Airbill" is the shipping paper used to document the information associated with the shipment. As identified previously, only personnel who have participated in "Shipping Hazardous Materials" training (or equivalent course) are authorized to prepare hazardous materials for shipment - including preparation of associated shipping papers. Included in this training are instructions on what specific information is to be provided on the Airbill for hazardous materials typically shipped by TtNUS. Refer to the training course Student Manual or contact Health Sciences for this information.

The properly executed Chain-of-Custody Report must be included in the container. Use custody seals.

Using the Airbill of our common carrier (i.e., Federal Express) as an example, the following instructions apply to the information to be provided under "Transport Details", "Nature and Quantity of Dangerous Goods", and other associated fields.

a) Transport Details

- Select "Passenger and Cargo" or "Cargo Aircraft Only" (This is based on the type and quantity of dangerous goods you are shipping). X-out the non-applicable selection.

- Airport of Departure - Enter the full name of the airport or city of departure.

- Airport of Destination - Enter the full name of the airport or city of destination.

b) Shipment Type – Delete the option that does not apply (Non-Radioactive/Radioactive)

c) Nature and Quantity of Dangerous Goods

1. Dangerous Goods Identification

   - Proper Shipping Name - List the proper shipping name (this is the name as it appears on the List of Dangerous Goods Table and NOT the product or trade name), and if applicable, the technical name in parenthesis.

   - Class or Division - List the class or division number and, if applicable, compatibility group.

   - UN or ID No - List the UN or I.D. number, preceded with "UN" or "I.D." This selection may change when shipping in accordance with 49 CFR regulations that permit the shipment under NA (North American Continental Shipments) designations for certain substances.

   - Packing Group – List the appropriate packing group, if applicable. This is the level of anticipated hazard of the shipment. It does not apply for all shipments. When no information is available, leave the space blank.

   - Subsidiary Risk – List the class or division number of the subsidiary risk, if applicable. The subsidiary risk is any additional hazard beyond the most significant (or primary) hazard. This information is obtained from the List of Dangerous Goods Table.

2. Quantity and Type of Packaging – List the number of packages, the type of package, and the net quantity in each package. The type of packaging you are shipping the hazardous material in is presented first, followed by the amount (Kg, L, etc.). For example, "1 fiberboard box X 2 Kg". When no outer packaging is identified, the packaging selected must provide limited protection of the inner packaging by securing and cushioning during shipment. NOTE: Always use the package that the hazardous material was shipped to the site in. If it is not available, contact the Health Sciences Department in Pittsburgh for further instruction.

3. Packing Instructions – Enter the Packing Instruction number. These instructions are provided in Section 5 of the IATA Dangerous Goods Regulations. They provide the exact type of packaging required by the industry for various hazard classes. When no addition packaging considerations are given, the shipper may use their best judgment for the shipment of an identified substance and/or article.

4. Authorization – List the words " Limited Quantity," if applicable; list any special provision(s) or approval(s) if applicable. This section provides for exceptions to this transportation regulation and the conditions for those exceptions.

d) Additional handling Information - Enter any required special handling information.

e) Prepared for Air Transport according to: Check the ICAO/IATA box.

f) Emergency Telephone Number - Enter the 24-hour emergency contact number. This number is required of all US Origin or Destination Shipments. List the number for InfoTRAC (1-800-535-5053). InfoTRAC is a company retained by TtNUS to provide 24-Hour Emergency Hotline service for dangerous goods shipment. This company has MSDSs for the substances routinely shipped by TtNUS. They provide information to FedEx or any other emergency responders, should situations arise with one of our shipments. In addition, they have telephone numbers of certain Tetra Tech NUS Health Science Department personnel in the Pittsburgh Office in the event of an emergency.

g) Name/Title of the Signatory - Enter name and job title (Field Operations Leader, Geologist, Health & Safety Specialist, etc.)

h) Place and date - Enter the city and date of shipment

i) Signature - Sign the form (must be a complete signature). All alterations must be signed with the same signature used to sign the declaration.

5.4.3.4 Transportation

1. The majority of unknown hazardous substance samples will be classified as flammable liquids. The samples will be transported by rented or common carrier truck, railroad, or express overnight package services. Do not transport samples on any passenger-carrying air transport system, even if the system has cargo-only aircraft. DOT regulations permit regular airline cargo-only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airline carriers that carry only cargo. If unsure of what mode of transportation to use, consult Health Sciences.[1]

2. For transport by government-owned vehicle, including aircraft, DOT regulations do not apply. However, procedures described above, with the exception of execution of the bill of lading with certification, shall still be followed.

3. Use the hazardous materials shipping check list (Attachment E) as a guidance to ensure that all sample-handling requirements are satisfied.

4. In some cases, various materials may react if they break during shipment. To determine if you are shipping such materials, refer to the DOT compatibility chart in Attachment F.

5.5 Shipment of Lithium Batteries

Monitoring well data are analyzed using either the Hermit SE 1000 or the Hermit SE 2000 environmental data logger. These instruments are typically powered by lithium batteries in sufficient quantity to make the unit subject to hazardous material shipping requirements. The DOT determined that lithium batteries are to be shipped using the following information:

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1 Note: If you are unsure as how to ship the sample (hazardous or environmental sample), contact Health Sciences so that a decision can be made as to the proper shipping practices. The DOT and IATA penalties for improper shipment of a hazardous material are stringent and may include a prison term for intentional violations.

- Product Designation
  - Hermit SE 1000
  - Hermit SE 2000

- Proper Shipping Name
  - Lithium batteries, contained in equipment, UN3091

- UN No - UN-3091

- Classification or Division
  - Class 9

Shipment of equipment containing lithium batteries must be accompanied by shipping papers completed as indicated in Attachment G. The instrument will be shipped by Federal Express as a Hazardous Material. Place the instrument in the same container in which it was received. This container or case is a DOT-approved shipping container. For Federal Express procedures to ship hazardous materials, call 1-800-238-5355, extension 922-1666. In most cases, the return shipping papers and DOT labels will be shipped to you from the company warehouse or the vendor. An example of the types of labels used for shipment and the wording are shown in Attachment G. These labels will be attached to the outside container and include all the information noted under Section 5.4.3.2. Instead of the Flammable Liquid information, however, the following will be presented with the following wording:

- Lithium Batteries Contained in Equipment
  - UN-3091

- DOT Miscellaneous Hazardous Materials (Class 9) label

- "Cargo Aircraft Only" label

6.0 REFERENCES

American Public Health Association, 1981. Standard Methods for the Examination of Water and Wastewater, 15th Edition. APHA, Washington, D.C.

International Air Transport Association (latest issue). Dangerous Goods Regulations, Montreal, Quebec, Canada.

U.S. Department of Transportation (latest issue). Hazardous Materials Regulations, 49 CFR 171-177.

U.S. EPA, 1984. "Guidelines Establishing Test Procedures for the Analysis of Pollutants under Clean Water Act." Federal Register, Volume 49 (209), October 26, 1984, p. 43234.

U.S. EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA-600/4-79-020, U.S. EPA-EMSL, Cincinnati, Ohio.

ATTACHMENT A

GENERAL SAMPLE CONTAINER AND PRESERVATION REQUIREMENTS

Sample Type and Concentration			Container[1]	Sample Size	Preservation[2]	Holding Time[2]
WATER						
Organics (GC&GC/MS)	VOC	Low	Borosilicate glass	2 x 40 mL	Cool to 4°C HCl to ≤ 2	14 days[9]
	Extractables SVOCs and pesticide/PCBs)	(Low	Amber glass	2x2 L or 4x1 L	Cool to 4°C	7 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticide/PCBs)	(Medium	Amber glass	2x2 L or 4x1 L	None	7 days to extraction; 40 days after extraction
Inorganics	Metals	Low	High-density polyethylene	1 L	HNO_3 to pH ≤2	6 months (Hg-28 days)
		Medium	Wide-mouth glass	16 oz.	None	6 months
	Cyanide	Low	High-density polyethylene	1 L	NaOH to pH>12	14 days
	Cyanide	Medium	Wide-mouth glass	16 oz.	None	14 days
Organic/ Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	14 days
SOIL						
Organics (GC&GC/MS)	VOC		Wide-mouth glass with teflon liner	2 x 4 oz.	Cool to 4°C	14 days
	Extractables SVOCs and pesticides/PCBs)	(Low	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
	Extractables SVOCs and pesticides/PCBs)	(Medium	Wide-mouth glass	8 oz.	Cool to 4°C	14 days to extraction; 40 days after extraction
Inorganics	Low/Medium		Wide-mouth glass	8 oz.	Cool to 4°C	6 months (Hg - 28 days) Cyanide (14 days)
Organic/Inorganic	High Hazard		Wide-mouth glass	8 oz.	None	NA
Dioxin/Furan	All		Wide-mouth glass	4 oz.	None	7 days until extraction; 40 days after extraction
TCLP	All		Wide-mouth glass	8 oz.	None	7 days until preparation; analysis as per fraction
AIR						
Volatile Organics	Low/Medium		Charcoal tube -- 7 cm long, 6 mm OD, 4 mm ID	100 L air	Cool to 4°C	5 days recommended

1 All glass containers should have Teflon cap liners or septa.
2 See Attachment E. Preservation and maximum holding time allowances per 40 CFR 136.

ATTACHMENT B

ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES

Parameter Number/Name	Container(1)	Preservation(2)(3)	Maximum Holding Time(4)
INORGANIC TESTS:			
Acidity	P, G	Cool, 4°C	14 days
Alkalinity	P, G	Cool, 4°C	14 days
Ammonia - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Biochemical Oxygen Demand (BOD)	P, G	Cool, 4°C	48 hours
Bromide	P, G	None required	28 days
Chemical Oxygen Demand (COD)	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Chloride	P, G	None required	28 days
Chlorine, Total Residual	P, G	None required	Analyze immediately
Color	P, G	Cool, 4°C	48 hours
Cyanide, Total and Amenable to Chlorination	P, G	Cool, 4°C; NaOH to pH 12; 0.6 g ascorbic acid(5)	14 days(6)
Fluoride	P	None required	28 days
Hardness	P, G	HNO_3 to pH 2; H_2SO_4 to pH 2	6 months
Total Kjeldahl and Organic Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrate - Nitrogen	P, G	None required	48 hours
Nitrate-Nitrite - Nitrogen	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Nitrite - Nitrogen	P, G	Cool, 4°C	48 hours
Oil & Grease	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Total Organic Carbon (TOC)	P, G	Cool, 4°C; HCl or H_2SO_4 to pH 2	28 days
Orthophosphate	P, G	Filter immediately; Cool, 4°C	48 hours
Oxygen, Dissolved-Probe	G Bottle & top	None required	Analyze immediately
Oxygen, Dissolved-Winkler	G Bottle & top	Fix on site and store in dark	8 hours
Phenols	G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Phosphorus, Total	P, G	Cool, 4°C; H_2SO_4 to pH 2	28 days
Residue, Total	P, G	Cool, 4°C	7 days
Residue, Filterable (TDS)	P, G	Cool, 4°C	7 days
Residue, Nonfilterable (TSS)	P, G	Cool, 4°C	7 days
Residue, Settleable	P, G	Cool, 4°C	48 hours
Residue, Volatile (Ash Content)	P, G	Cool, 4°C	7 days
Silica	P	Cool, 4°C	28 days
Specific Conductance	P, G	Cool, 4°C	28 days
Sulfate	P, G	Cool, 4°C	28 days

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE TWO

Parameter Number/Name	Container[1]	Preservation[2][3]	Maximum Holding Time[4]
INORGANIC TESTS (Cont'd):			
Sulfide	P, G	Cool, 4°C; add zinc acetate plus sodium hydroxide to pH 9	7 days
Sulfite	P, G	None required	Analyze immediately
Turbidity	P, G	Cool, 4°C	48 hours
METALS:[7]			
Chromium VI (Hexachrome)	P, G	Cool, 4°C	24 hours
Mercury (Hg)	P, G	HNO_3 to pH 2	28 days
Metals, except Chromium VI and Mercury	P, G	HNO_3 to pH 2	6 months
ORGANIC TESTS:[8]			
Purgeable Halocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	14 days
Purgeable Aromatic Hydrocarbons	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] HCl to pH 2 [9]	14 days
Acrolein and Acrylonitrile	G, Teflon-lined septum	Cool, 4°C; 0.008% $Na_2S_2O_3$[5] adjust pH to 4-5 [10]	14 days
Phenols[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Benzidines[11], [12]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction[13]
Phthalate esters[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitrosamines[11], [14]	G, Teflon-lined cap	Cool, 4°C; store in dark; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
PCBs[11]	G, Teflon-lined cap	Cool, 4°C	7 days until extraction; 40 days after extraction
Nitroaromatics & Isophorone[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Polynuclear Aromatic Hydrocarbons (PAHs)[11],[14]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]; store in dark	7 days until extraction; 40 days after extraction
Haloethers[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction
Dioxin/Furan (TCDD/TCDF)[11]	G, Teflon-lined cap	Cool, 4°C; 0.008% $Na_2S_2O_3$[5]	7 days until extraction; 40 days after extraction

ATTACHMENT B
ADDITIONAL REQUIRED CONTAINERS, PRESERVATION TECHNIQUES, AND HOLDING TIMES
PAGE THREE

(1) Polyethylene (P): generally 500 ml or Glass (G): generally 1L.
(2) Sample preservation should be performed immediately upon sample collection. For composite chemical samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.
(3) When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172).
(4) Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer periods, and has received a variance from the Regional Administrator.
(5) Should only be used in the presence of residual chlorine.
(6) Maximum holding time is 24 hours when sulfide is present. Optionally, all samples may be tested with lead acetate paper before pH adjustments are made to determine if sulfide is present. If sulfide is present, it can be removed by the addition of cadmium nitrate powder until a negative spot test is obtained. The sample is filtered and then NaOH is added to pH 12.
(7) Samples should be filtered immediately on site before adding preservative for dissolved metals.
(8) Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.
(9) Sample receiving no pH adjustment must be analyzed within 7 days of sampling.
(10) The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.
(11) When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity. When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to 4°C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6-9; samples preserved in this manner may be held for 7 days before extraction and for 40 days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (re: the requirement for thiosulfate reduction of residual chlorine) and footnotes 12, 13 (re: the analysis of benzidine).
(12) If 1,2-diphenylthydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.
(13) Extracts may be stored up to 7 days before analysis if storage is conducted under an inert (oxidant-free) atmosphere.
(14) For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7-10 with NaOH within 24 hours of sampling.
(15) The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

ATTACHMENT C

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2a)

1. Radioactive material (except a limited quantity)
2. Division 2.3, Poisonous Gases
3. Division 2.1, Flammable Gas
4. Division 2.2, Nonflammable gas
5. Division 6.1, Poisonous Liquids, Packing Group 1 (poison by inhalation only)
6. Division 4.2, Pyrophoric Material
7. Division 4.1, Self-Reactive Material
8. Class 3, Flammable Liquids*
9. Class 8, Corrosive Material
10. Division 4.1, Flammable Solid*
11. Division 4.2, Spontaneously Combustible Materials*
12. Division 4.3, Dangerous When Wet Materials*
13. Division 5.1, Oxidizers*
14. Division 6.1, Poisonous Liquids or Solids (other than Packing Group 1)*
15. Combustible liquid
16. Class 9, Miscellaneous Hazardous Materials

* If a material has or meets the criteria for more than one hazard class, use the precedence of hazardous table on the following page for Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1. The following table ranks those materials that meet the definition of Classes 3 and 8 and Divisions 4.1, 4.2, 4.3, 5.1, and 6.1.

ATTACHMENT C (Continued)

DOT HAZARDOUS MATERIAL CLASSIFICATION (49 CFR 173.2a)

Class	Packing Group	4.2	4.3	5.1 I[a]	5.1 II[a]	5.1 III[a]	6.1 I (Dermal)	6.1 I (Oral)	6.1 II	6.1 III	8 I (Liquid)	8 I (Solid)	8 II (Liquid)	8 II (Solid)	8 III (Liquid)	8 III (Solid)
3	I						3	3	3	3	3	[c]	3	[c]	3	[c]
3	II						3	3	3	3	8	[c]	3	[c]	3	[c]
3	III						6.1	6.1	6.1	3[d]	8	[c]	8	[c]	3	[c]
4.1	II[b]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	4.1	4.1	[c]	8	[c]	4.1	[c]	4.1
4.1	III[b]	4.2	4.3	5.1	4.1	4.1	6.1	6.1	6.1	4.1	[c]	8	[c]	8	[c]	4.1
4.2	II		4.3	5.1	4.2	4.2	6.1	6.1	4.2	4.2	[c]	8	[c]	4.2	[c]	4.2
4.2	III		4.3	5.1	4.2	4.2	6.1	6.1	6.1	4.2	[c]	8	[c]	8	[c]	4.2
4.3	I			5.1	4.3	4.3	6.1	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3	4.3
4.3	II			5.1	4.3	4.3	6.1	4.3	4.3	4.3	8	8	8	4.3	4.3	4.3
4.3	III			5.1	4.3	4.3	6.1	6.1	6.1	4.3	8	8	8	8	4.3	4.3
5.1	I[a]						5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
5.1	II[a]						6.1	5.1	5.1	5.1	8	8	8	5.1	5.1	5.1
5.1	III[a]						6.1	6.1	6.1	5.1	8	8	8	8	5.1	5.1
6.1	I, Dermal										8	6.1	6.1	6.1	6.1	6.1
6.1	I, Oral										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Inhalation										8	6.1	6.1	6.1	6.1	6.1
6.1	II, Dermal										8	6.1	8	6.1	6.1	6.1
6.1	II, Oral										8	8	8	6.1	6.1	6.1
6.1	III										8	8	8	8	8	8

[a] There are at present no established criteria for determining Packing Groups for liquids in Division 5.1. At present, the degree of hazard is to be assessed by analogy with listed substances, allocating the substances to Packing Group I, Great; Group II, Medium; or Group III, Minor Danger.

[b] Substances of Division 4.1 other than self-reactive substances.

[c] Denotes an impossible combination.

[d] For pesticides only, where a material has the hazards of Class 3, Packing Group III, and Division 6.1, Packing Group III, the primary hazard is Division 6.1, Packing Group III.

ATTACHMENT D

GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

USE OF GUIDE - This guide is presented as an aid to shippers of hazardous materials. It does not contain or refer to all of the DOT requirements for shipping hazardous materials. For specific details, refer to all of the DOT requirements for shipping hazardous materials, as provided in the Code of Federal Regulations (CFR), Title 49, Transportation, Parts 100-199.

The following is offered as a step-by-step procedure to aid in compliance with the applicable DOT regulations.

STEP 1 - DETERMINE THE PROPER SHIPPING NAME. The shipper must determine the proper shipping name of the materials as listed in the Hazardous Materials Table, 49 CFR 172.101, Column (2).

STEP 2 - DETERMINE THE HAZARD CLASS OR CLASSES.

a. Refer to the Table, 49 CFR 172.101, Column (3), and locate the hazard class of the material.
b. If more than one class is shown for the proper shipping name, determine the proper class by definition.
c. If the materials have more than one hazard, classify the material based on the order of hazards in 49 CFR 173.2.

STEP 3 - SELECT THE PROPER IDENTIFICATION NUMBERS.

a. Refer to the Table, 49 CFR 172.101, Column (3a), and select the Identification Number (ID) that corresponds to the proper shipping name and hazard class.
b. Enter the ID number(s) on the shipping papers and display them, as required, on packagings, placards and/or orange panels.

STEP 4 - DETERMINE THE MODE(S) OF TRANSPORT TO ULTIMATE DESTINATION.

a. As a shipper, you must assure yourself that the shipment complies with various modal requirements.
b. The modal requirements may affect the following: (1) Packaging; (2) Quantity per Package; (3) Marking; (4) Labeling; (5) Shipping Papers; and (6) Certification.

STEP 5 - SELECT THE PROPER LABEL(S) AND APPLY AS REQUIRED.

a. Refer to the Table, 49 CFR 172.101, Column (4) for required labels.
b. For details on labeling refer to (1) Additional Labels, 49 CFR 172.402; (2) Placement of Labels, 49 CFR 172.406; (3) Packagings (Mixed or Consolidated), 49 CFR 172.404(a) and (h); (4) Packages Containing Samples, 49 CFR 172.402(h); (5) Radioactive Materials, 49 CFR 172.403; and (6) Authorized Label Modifications, 49 CFR 172.405.

STEP 6 - DETERMINE AND SELECT THE PROPER PACKAGES.

a. Refer to the Table, 49 CFR 172.101, Column (5a) for exceptions and Column (5b) for specification packagings. Consider the following when selecting an authorized package: Quantity per Package; Cushioning Material, if required; Proper Closure and Reinforcement; Proper Pressure; Outage; etc., as required.
b. If packaged by a prior shipper, make sure the packaging is correct and in proper condition for transportation.

ATTACHMENT D (Continued)
GUIDE FOR HAZARDOUS MATERIALS SHIPPERS

STEP 7 - MARK THE PACKAGING (INCLUDING OVERPACKS).

a. Apply the required markings (49 CFR 172.300); Proper shipping name and ID number, when required (49 CFR 172.301); Name and address of Consignee or Consignor (49 CFR 172.306).
b. For details and other required markings, see 49 CFR 172.300 through 172.338.

STEP 8 - PREPARE THE SHIPPING PAPERS.

a. The basic requirements for preparing shipping papers include Proper Shipping Name; Hazard Class; ID Number; Total Quantity; Shipper's Certification; and Emergency Response Telephone Number.
b. Make all entries on the shipping papers using the information required and in proper sequence (49 CFR 172.202).

STEP 9 - CERTIFICATION.

a. Each shipper must certify by printing (manually or mechanically) on the shipping papers that the materials being offered for shipment are properly classified, described, packaged, marked and labeled, and in proper condition for transportation according to the applicable DOT Regulations (49 CFR 172.202).

STEP 10 - LOADING, BLOCKING, AND BRACING. When hazardous materials are loaded into the transport vehicle or freight container, each package must be loaded, blocked, and braced in accordance with the requirements for mode of transport.

a. If the shipper loads the freight container or transport vehicle, the shipper is responsible for the proper loading, blocking, and bracing of the materials.
b. If the carrier does the loading, the carrier is responsible.

STEP 11 - DETERMINE THE PROPER PLACARD(S). Each person who offers hazardous materials for transportation must determine that the placarding requirements have been met.

a. For Highway, unless the vehicle is already correctly placarded, the shipper must provide the required placard(s) and required ID number(s) (49 CFR 172.506).
b. For Rail, if loaded by the shipper, the shipper must placard the rail car if placards are required (49 CFR 172.508).
c. For Air and Water shipments, the shipper has the responsibility to apply the proper placards.

STEP 12 - HAZARDOUS WASTE/HAZARDOUS SUBSTANCE.

a. If the material is classed as a hazardous waste or hazardous substance, most of the above steps will be applicable.
b. Pertinent Environmental Protection Agency regulations are found in the Code of Federal Regulations, Title 40, Part 262.

As a final check and before offering the shipment for transportation, visually inspect the shipment. The shipper should ensure that emergency response information is on the vehicle for transportation of hazardous materials.

Revised March 1995.

ATTACHMENT E

HAZARDOUS MATERIALS SHIPPING CHECK LIST

PACKAGING

1. Check DOT 173.24 for appropriate type of package for hazardous substance.
2. Check for container integrity, especially the closure.
3. Check for sufficient absorbent material in package.
4. Check for sample tags and log sheets for each sample and for chain-of-custody record.

SHIPPING PAPERS

1. Check that entries contain only approved DOT abbreviations.
2. Check that entries are in English.
3. Check that hazardous material entries are specially marked to differentiate them from any nonhazardous materials being sent using same shipping paper.
4. Be careful that all hazardous classes are shown for multiclass materials.
5. Check total amounts by weight, quantity, or other measures used.
6. Check that any limited-quantity exemptions are so designated on the shipping paper.
7. Check that certification is signed by shipper.
8. Make certain driver signs for shipment.

RCRA MANIFEST

1. Check that approved state/federal manifests are prepared.
2. Check that transporter has the following: valid EPA identification number, valid driver's license, valid vehicle registration, insurance protection, and proper DOT labels for materials being shipped.
3. Check that destination address is correct.
4. Check that driver knows where shipment is going.
5. Check that the driver is aware of emergency procedures for spills and accidents.
6. Make certain driver signs for shipment.
7. Make certain one copy of executed manifest and shipping document is retained by shipper.

ATTACHMENT F
DOT SEGREGATION AND SEPARATON CHART

Class or Division	Notes	1.1-1.2	1.3	1.4	1.5	1.6	2.1	2.2	2.3 gas Zone A*	2.3 gas Zone B*	3	4.1	4.2	4.3	5.1	5.2	6.1 liquids PG-I Zone A*	7	8 liquids only
Explosives... 1.1 and 1.2	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Explosives................ 1.3		*	*	*	*	*	X		X	X	X		X	X	X	X	X		X
Explosives................ 1.4		*	*	*	*	*	O		O	O	O		O				O		O
Very insensitive explosives................ 1.5	A	*	*	*	*	*	X	X	X	X	X	X	X	X	X	X	X	X	X
Extremely insensitive explosives................ 1.6		*	*	*	*	*													
Flammable gases.... 2.1		X	X	O	X				X	O							O	O	
Non-toxic, non-flammable gases 2.2		X			X														
Poisonous gas - Zone A** 2.3		X	X	O	X		X				X	X	X	X	X	X			X
Poisonous gas - Zone B** 2.3		X	X	O	X		O				O	O	O	O	O	O			O
Flammable liquids....... 3		X	X	O	X				X	O					O		X		
Flammable solids..... 4.1		X			X				X	O							X		O
Spontaneously combustible materials.................. 4.2		X	X	O	X				X	O							X		X
Dangerous-when-wet materials.................. 4.3		X	X		X				X	O							X		O
Oxidizers.................. 5.1	A	X	X		X				X	O	O						X		O
Organic peroxides.... 5.2		X	X		X				X	O							X		O
Poisonous liquids PG I - Zone A** 6.1		X	X	O	X		O				X	X	X	X	X	X			X
Radioactive materials . 7		X			X		O												
Corrosive liquids 8		X	X	O	X				X	O		O	X	O	O	O	X		

No entry means that the materials are compatible (have no restrictions).

X These materials may not be loaded, transported, or stored together in the same vehicle or facility.
O The materials may not be loaded, transported, or stored together in the same vehicle or facility unless they are separated for 4 feet on all sides.
* Check the explosives compatibility chart in 49 CFR 179.848(f).
A Ammonium nitrate fertilizers may be stored with Division 1.1 materials.
** Denotes inhalation hazardous for poisons; consult field team leader or project manager if you encounter a material in this class
1 before shipment.

ATTACHMENT G
LITHIUM BATTERY SHIPPING PAPERS

3224637861

Two completed and signed copies of this Declaration must be handed to the operator.

WARNING

Failure to comply in all respects with the applicable Dangerous Goods Regulations may be in breach of the applicable law, subject to legal penalties. This Declaration must not, in any circumstances, be completed and/or signed by a consolidator, a forwarder or an IATA cargo agent.

TRANSPORT DETAILS

This shipment is within the limitations prescribed for: *(delete non applicable)*

~~PASSENGER AND CARGO AIRCRAFT~~	CARGO AIRCRAFT ONLY	Airport of Departure

Airport of Destination: 19CYS

Shipment type: *(delete non-applicable)* NON-RADIOACTIVE ~~RADIOACTIVE~~

NATURE AND QUANTITY OF DANGEROUS GOODS

Dangerous Goods Identification						
Proper Shipping Name	Class or Division	UN or ID No.	Subsidiary Risk	Quantity and type of packing	Packing Inst.	Authorization
LITHIUM BATTERIES CONTAINED IN EQUIPMENT	9	UN3091		1 PLASTIC BOX X 55 GRAMS	912 II	PER CA-9206009

FOR SHIPMENTS WITHIN USA, AK AND HI ONLY

Additional Handling Information

1 HERMIT SERIES DATALOGGER X 55 GRAMS (11 GRAMS/CELL)

I hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in the proper condition for transport by air according to the applicable International and National Government Regulations.

Name/Title of Signatory

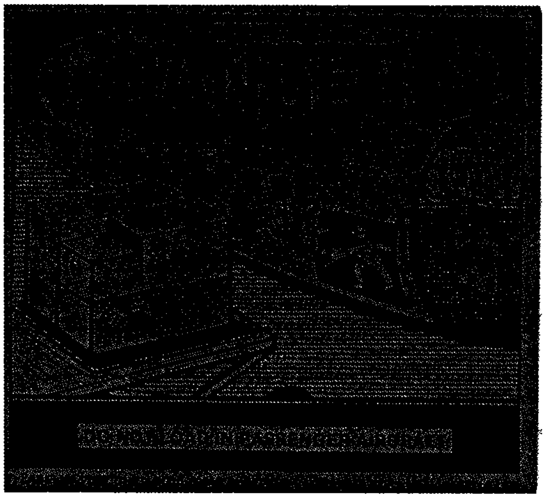
Place and Date

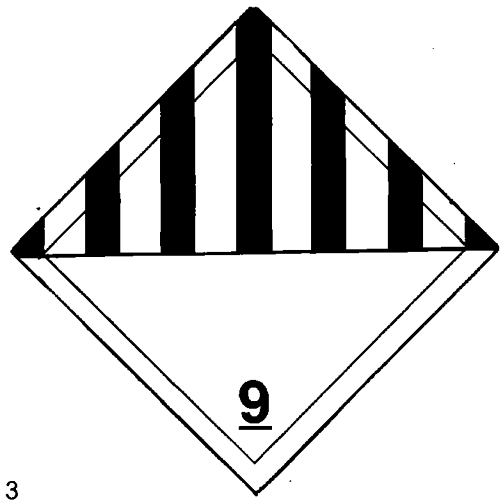
Signature *(see warning above)*

Emergency Telephone Number (Required for US Origin or Destination Shipments)
800-535-5053

IF ACCEPTABLE FOR PASSENGER AIRCRAFT, THIS SHIPMENT CONTAINS RADIOACTIVE MATERIAL INTENDED FOR USE IN, OR INCIDENT TO, RESEARCH, MEDICAL DIAGNOSIS, OR TREATMENT.

ATTACHMENT G (CONTINUED)
LITHIUM BATTERY SHIPPING PAPERS





3

LITHIUM BATTERIES CONTAINED IN EQUIPMENT.
UN-3091.
SHIPPED UNDER CA-9206009

TETRA TECH NUS, INC.	**STANDARD OPERATING PROCEDURES**	Number: SA-6.3	Page: 1 of 37
		Effective Date: 01/00	Revision: 1
		Applicability: Tetra Tech NUS, Inc.	
		Prepared: Earth Sciences Department	
Subject: FIELD DOCUMENTATION		Approved: D. Senovich	

TABLE OF CONTENTS

SECTION **PAGE**

TABLE OF CONTENTS (Continued)

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to identify and designate the field data record forms, logs and reports generally initiated and maintained for documenting Tetra Tech NUS field activities.

2.0 SCOPE

Documents presented within this procedure (or equivalents) shall be used for all Tetra Tech NUS field activities, as applicable. Other or additional documents may be required by specific client contracts or project planning documents.

3.0 GLOSSARY

None

4.0 RESPONSIBILITIES

Project Manager (PM) - The Project Manager is responsible for obtaining hardbound, controlled-distribution logbooks (from the appropriate source), as needed. In addition, the Project Manager is responsible for placing all field documentation used in site activities (i.e., records, field reports, sample data sheets, field notebooks, and the site logbook) in the project's central file upon the completion of field work.

Field Operations Leader (FOL) - The Field Operations Leader is responsible for ensuring that the site logbook, notebooks, and all appropriate and current forms and field reports illustrated in this guideline (and any additional forms required by the contract) are correctly used, accurately filled out, and completed in the required time-frame.

5.0 PROCEDURES

5.1 Site Logbook

5.1.1 General

The site logbook is a hard-bound, paginated, controlled-distribution record book in which all major onsite activities are documented. At a minimum, the following activities/events shall be recorded or referenced (daily) in the site logbook:

- All field personnel present
- Arrival/departure of site visitors
- Arrival/departure of equipment
- Start and/or completion of borehole, trench, monitoring well installation, etc.
- Daily onsite activities performed each day
- Sample pickup information
- Health and Safety issues (level of protection observed, etc.)
- Weather conditions

A site logbook shall be maintained for each project. The site logbook shall be initiated at the start of the first onsite activity (e.g., site visit or initial reconnaissance survey). Entries are to be made for every day that onsite activities take place which involve Tetra Tech NUS or subcontractor personnel. Upon completion of the fieldwork, the site logbook must become part of the project's central file.

The following information must be recorded on the cover of each site logbook:

- Project name
- Tetra Tech NUS project number
- Sequential book number
- Start date
- End date

Information recorded daily in the site logbook need not be duplicated in other field notebooks (see Section 5.2), but must summarize the contents of these other notebooks and refer to specific page locations in these notebooks for detailed information (where applicable). An example of a typical site logbook entry is shown in Attachment A.

If measurements are made at any location, the measurements and equipment used must either be recorded in the site logbook or reference must be made to the field notebook in which the measurements are recorded (see Attachment A).

All logbook, notebook, and log sheet entries shall be made in indelible ink (black pen is preferred). No erasures are permitted. If an incorrect entry is made, the data shall be crossed out with a single strike mark, and initialed and dated. At the completion of entries by any individual, the logbook pages used must be signed and dated. The site logbook must also be signed by the Field Operations Leader at the end of each day.

5.1.2 Photographs

When movies, slides, or photographs are taken of a site or any monitoring location, they must be numbered sequentially to correspond to logbook/notebook entries. The name of the photographer, date, time, site location, site description, and weather conditions must be entered in the logbook/notebook as the photographs are taken. A series entry may be used for rapid-sequence photographs. The photographer is not required to record the aperture settings and shutter speeds for photographs taken within the normal automatic exposure range. However, special lenses, films, filters, and other image-enhancement techniques must be noted in the logbook/notebook. If possible, such techniques shall be avoided, since they can adversely affect the accuracy of photographs. Chain-of-custody procedures depend upon the subject matter, type of film, and the processing it requires. Film used for aerial photography, confidential information, or criminal investigation require chain-of-custody procedures. Once processed, the slides of photographic prints shall be consecutively numbered and labeled according to the logbook/notebook descriptions. The site photographs and associated negatives must be docketed into the project's central file.

5.2 <u>Field Notebooks</u>

Key field team personnel may maintain a separate dedicated field notebook to document the pertinent field activities conducted directly under their supervision. For example, on large projects with multiple investigative sites and varying operating conditions, the Health and Safety Officer may elect to maintain a separate field notebook. Where several drill rigs are in operation simultaneously, each site geologist assigned to oversee a rig must maintain a field notebook.

5.3 <u>Sample Forms</u>

A summary of the forms illustrated in this procedure is shown as the listing of Attachments in the Table of Contents for this SOP. Forms may be altered or revised for project-specific needs contingent upon client approval. Care must be taken to ensure that all essential information can be documented. Guidelines for completing these forms can be found in the related sampling SOP.

5.3.1 Sample Collection, Labeling, Shipment, Request for Analysis, and Field Test Results

5.3.1.1 Sample Log Sheet

Sample Log Sheets are used to record specified types of data while sampling. Attachments B-1 to B-4 are examples of Sample Log Sheets. The data recorded on these sheets are useful in describing the waste source and sample as well as pointing out any problems, difficulties, or irregularities encountered during sampling. A log sheet must be completed for each sample obtained, including field quality control (QC) samples.

5.3.1.2 Sample Label

A typical sample label is illustrated in Attachment B-5. Adhesive labels must be completed and applied to every sample container. Sample labels can usually be obtained from the appropriate Program source electronically generated in-house, or are supplied from the laboratory subcontractor.

5.3.1.3 Chain-of-Custody Record Form

The Chain-of-Custody (COC) Record is a multi-part form that is initiated as samples are acquired and accompanies a sample (or group of samples) as they are transferred from person to person. This form must be used for any samples collected for chemical or geotechnical analysis whether the analyses are performed on site or off site. One carbonless copy of the completed COC form is retained by the field crew, one copy is sent to the Project Manager, while the original is sent to the laboratory. The original (top, signed copy) of the COC form shall be placed inside a large Ziploc-type bag and taped inside the lid of the shipping cooler. If multiple coolers are sent but are included on one COC form, the COC form should be sent with the first cooler. The COC form should then state how many coolers are included with that shipment. An example of a Chain-of-Custody Record form is provided as Attachment B-6. Once the samples are received at the laboratory, the sample cooler and contents are checked and any problems are noted on the enclosed COC form (any discrepancies between the sample labels and COC form and any other problems that are noted are resolved through communication between the laboratory point-of-contact and the Tetra Tech NUS Project Manager). The COC form is signed and copied. The laboratory will retain the copy while the original becomes part of the samples' corresponding analytical data package.

5.3.1.4 Chain-of-Custody Seal

Attachment B-7 is an example of a custody seal. The Custody seal is an adhesive-backed label. It is part of a chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field and sealed in coolers for transport to the laboratory. The COC seals are signed and dated by the samplers and affixed across the opening edges of each cooler containing environmental samples. COC seals may be available from the laboratory; these seals may also be purchased from a supplier.

5.3.1.5 Field Analytical Log Sheets for Geochemical Parameters

Field Analytical Log Sheets (Attachment B-8) are used to record geochemical and/or natural attenuation field test results. Attachments B-8 (3-page form) should be used when applicable.

5.3.2 Hydrogeological and Geotechnical Forms

5.3.2.1 Groundwater Level Measurement Sheet

A groundwater level measurement sheet, shown in Attachment C-1 must be filled out for each round of water level measurements made at a site.

5.3.2.2 Data Sheet for Pumping Test

During the performance of a pumping test (or an in-situ hydraulic conductivity test), a large amount of data must be recorded, often within a short time period. The pumping test data sheet (Attachment C-2) facilitates this task by standardizing the data collection format, and allowing the time interval for collection to be laid out in advance.

5.3.2.3 Packer Test Report Form

A packer test report form shown in Attachment C-3 must be completed for each well upon which a packer test is conducted.

5.3.2.4 Summary Log of Boring

During the progress of each boring, a log of the materials encountered, operation and driving of casing, and location of samples must be kept. The Summary Log of Boring, or Boring Log, (Attachment C-4) is used for this purpose and must be completed for each soil boring performed. In addition, if volatile organics are monitored on cores, samples, cuttings from the borehole, or breathing zone, (using a PID or FID), these results must be entered on the boring log at the appropriate depth. The "Remarks" column can be used to subsequently enter the laboratory sample number, the concentration of key analytical results, or other pertinent information. This feature allows direct comparison of contaminant concentrations with soil characteristics.

5.3.2.5 Monitoring Well Construction Details Form

A Monitoring Well Construction Details Form must be completed for every monitoring well, piezometer, or temporary well point installed. This form contains specific information on length and type of well riser pipe and screen, backfill, filter pack, annular seal and grout characteristics, and surface seal characteristics. This information is important in evaluating the performance of the monitoring well, particularly in areas where water levels show temporal variation, or where there are multiple (immiscible) phases of contaminants. Depending on the type of monitoring well (in overburden or bedrock), different forms are used (see Attachments C-5 through C-9). Similar forms are used for flush-mount well completions.

5.3.2.6 Test Pit Log

When a test pit or trench is constructed for investigative or sampling purposes, a Test Pit Log (Attachment C-10) must be filled out by the responsible field geologist or sampling technician.

5.3.2.7 Miscellaneous Monitoring Well Forms

Monitoring Well Materials Certificate of Conformance (Attachment C-11) should be used as the project directs to document all materials utilized during each monitoring well installation.

The Monitoring Well Development Record (Attachment C-12) should be used as the project directs to document all well development activities.

5.3.3 Equipment Calibration and Maintenance Form

The calibration or standardization of monitoring, measuring or test equipment is necessary to assure the proper operation and response of the equipment, to document the accuracy, precision or sensitivity of the measurement, and determine if correction should be applied to the readings. Some items of equipment require frequent calibration, others infrequent. Some are calibrated by the manufacturer, others by the user.

Each instrument requiring calibration has its own Equipment Calibration Log (Attachment D) which documents that the manufacturer's instructions were followed for calibration of the equipment, including frequency and type of standard or calibration device. An Equipment Calibration Log must be maintained for each electronic measuring device used in the field; entries must be made for each day the equipment is used.

5.4 Field Reports

The primary means of recording onsite activities is the site logbook. Other field notebooks may also be maintained. These logbooks and notebooks (and supporting forms) contain detailed information required for data interpretation or documentation, but are not easily useful for tracking and reporting of progress. Furthermore, the field logbook/notebooks remain onsite for extended periods of time and are thus not accessible for timely review by project management.

5.4.1 Daily Activities Report

To provide timely oversight of onsite contractors, Daily Activities Reports are completed and submitted as described below.

5.4.1.1 Description

The Daily Activities Report (DAR) documents the activities and progress for each day's field work. This report must be filled out on a daily basis whenever there are drilling, test pitting, well construction, or other related activities occurring which involve subcontractor personnel. These sheets summarize the work performed and form the basis of payment to subcontractors (Attachment E is an example of a Daily Activities Report).

5.4.1.2 Responsibilities

It is the responsibility of the rig geologist to complete the DAR and obtain the driller's signature acknowledging that the times and quantities of material entered are correct.

5.4.1.3 Submittal and Approval

At the end of the shift, the rig geologist must submit the Daily Activities Report to the Field Operations Leader (FOL) for review and filing. The Daily Activities Report is not a formal report and thus requires no further approval. The DAR reports are retained by the FOL for use in preparing the site logbook and in preparing weekly status reports for submission to the Project Manager.

5.4.2 Weekly Status Reports

To facilitate timely review by project management, photocopies of logbook/notebook entries may be made for internal use.

It should be noted that in addition to the summaries described herein, other summary reports may also be contractually required. Attachment F is an example of a Field Trip Summary Report form.

6.0 ATTACHMENTS

Attachment A	TYPICAL SITE LOGBOOK ENTRY
Attachment B-1	EXAMPLE GROUNDWATER SAMPLE LOG SHEET
Attachment B-2	EXAMPLE SURFACE WATER SAMPLE LOG SHEET
Attachment B-3	EXAMPLE SOIL/SEDIMENT SAMPLE LOG SHEET
Attachment B-4	CONTAINER SAMPLE LOG SHEET FORM
Attachment B-5	SAMPLE LABEL
Attachment B-6	CHAIN-OF-CUSTODY RECORD FORM
Attachment B-7	CHAIN-OF-CUSTODY SEAL
Attachment B-8	FIELD ANALYTICAL LOG SHEET
Attachment C-1	EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET
Attachment C-2	EXAMPLE PUMPING TEST DATA SHEET
Attachment C-3	PACKER TEST REPORT FORM
Attachment C-4	EXAMPLE BORING LOG
Attachment C-5	EXAMPLE OVERBURDEN MONITORING WELL SHEET
Attachment C-5A	EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)
Attachment C-6	EXAMPLE CONFINING LAYER MONITORING WELL SHEET
Attachment C-7	EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL
Attachment C-8	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK
Attachment C-9	EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK (FLUSHMOUNT)
Attachment C-10	EXAMPLE TEST PIT LOG
Attachment C-11	MONITORING WELL MATERIALS CERTIFICATE OF CONFORMANCE
Attachment C-12	MONITORING WELL DEVELOPMENT RECORD
Attachment D	EXAMPLE EQUIPMENT CALIBRATION LOG
Attachment E	EXAMPLE DAILY ACTIVITIES RECORD
Attachment F	FIELD TRIP SUMMARY REPORT

ATTACHMENT A
TYPICAL SITE LOGBOOK ENTRY

START TIME: ____________________ DATE: ____________________

SITE LEADER: ____________________

PERSONNEL:

TtNUS	DRILLER	SITE VISITORS
____________	____________	____________
____________	____________	____________
____________	____________	____________

WEATHER: Clear, 68°F, 2-5 mph wind from SE

ACTIVITIES:

1. Steam jenney and fire hoses were set up.
2. Drilling activities at well ____ resumes. Rig geologist was ______________. See Geologist's Notebook, No. 1, page 29-30, for details of drilling activity. Sample No. 123-21-S4 collected; see sample logbook, page 42. Drilling activities completed at 11:50 and a 4-inch stainless steel well installed. See Geologist's Notebook, No. 1, page 31, and well construction details for well ______.
3. Drilling rig No. 2 steam-cleaned at decontamination pit. Then set up at location of well _______.
4. Well ______ drilled. Rig geologist was ___________________. See Geologist's Notebook, No. 2, page ____ for details of drilling activities. Sample numbers 123-22-S1, 123-22-S2, and 123-22-S3 collected; see sample logbook, pages 43, 44, and 45.
5. Well _____ was developed. Seven 55-gallon drums were filled in the flushing stage. The well was then pumped using the pitcher pump for 1 hour. At the end of the hour, water pumped from well was "sand free."
6. EPA remedial project manger arrives on site at 14:25 hours.
7. Large dump truck arrives at 14:45 and is steam-cleaned. Backhoe and dump truck set up over test pit _________.
8. Test pit _______ dug with cuttings placed in dump truck. Rig geologist was _______________. See Geologist's Notebook, No. 1, page 32, for details of test pit activities. Test pit subsequently filled. No samples taken for chemical analysis. Due to shallow groundwater table, filling in of test pit ___ resulted in a very soft and wet area. A mound was developed and the area roped off.
9. Express carrier picked up samples (see Sample Logbook, pages 42 through 45) at 17:50 hours. Site activities terminated at 18:22 hours. All personnel off site, gate locked.

____

Field Operations Leader

ATTACHMENT B-1

Tetra Tech NUS, Inc.

GROUNDWATER SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ____________
Project No.: ____________

[] Domestic Well Data
[] Monitoring Well Data
[] Other Well Type: ____________
[] QA Sample Type: ____________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________
Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (°C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
Date:								
Time:								
Method:								

PURGE DATA:	Volume	pH	S.C.	Temp.	Turbidity	DO	Salinity	Other
Date:								
Method:								
Monitor Reading (ppm):								
Well Casing Diameter & Material Type:								
Total Well Depth (TD):								
Static Water Level (WL):								
One Casing Volume(gal/L):								
Start Purge (hrs):								
End Purge (hrs):								
Total Purge Time (min):								
Total Vol. Purged (gal/L):								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

Circle if Applicable:		Signature(s):
MS/MSD	Duplicate ID No.:	

ATTACHMENT B-2

Tetra Tech NUS, Inc. **SURFACE WATER SAMPLE LOG SHEET**

Page___ of ___

Project Site Name: ____________
Project No.: ____________

[] Stream
[] Spring
[] Pond
[] Lake
[] Other: ____________
[] QA Sample Type: ____________

Sample ID No.: ____________
Sample Location: ____________
Sampled By: ____________
C.O.C. No.: ____________

Type of Sample:
[] Low Concentration
[] High Concentration

SAMPLING DATA:

	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{o}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other
Date:								
Time:								
Depth:								
Method:								

SAMPLE COLLECTION INFORMATION:

Analysis	Preservative	Container Requirements	Collected

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B-3

Tetra Tech NUS, Inc.

SOIL & SEDIMENT SAMPLE LOG SHEET

Page___ of ___

Project Site Name: ____________________
Project No.: ____________________

[] Surface Soil
[] Subsurface Soil
[] Sediment
[] Other: ____________________
[] QA Sample Type: ____________________

Sample ID No.: ____________________
Sample Location: ____________________
Sampled By: ____________________
C.O.C. No.: ____________________

Type of Sample:
[] Low Concentration
[] High Concentration

GRAB SAMPLE DATA:

	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Date:			
Time:			
Method:			
Monitor Reading (ppm):			

COMPOSITE SAMPLE DATA:

Date:	Time	Depth Interval	Color	Description (Sand, Silt, Clay, Moisture, etc.)
Method:				
Monitor Readings (Range in ppm):				

SAMPLE COLLECTION INFORMATION:

Analysis	Container Requirements	Collected	Other

OBSERVATIONS / NOTES:

MAP:

Circle if Applicable:

MS/MSD	Duplicate ID No.:

Signature(s):

ATTACHMENT B-4

Tetra Tech NUS, Inc.

CONTAINER SAMPLE & INSPECTION SHEET

Page____ of ____

Project Site Name: ______________
Project Number: ______________
Site Identification: ______________
Container Number(s): ______________
Sample Type: 0 Grab
0 Composite

Sample ID No. ______________
Sampled By: ______________
C.O.C. No. ______________
Concentration: 0 High
0 Medium
0 Low

CONTAINER SOURCE	CONTAINER DESCRIPTION
DRUM: 0 Bung Top 0 Lever Lock 0 Bolted Ring 0 Other ______	COLOR: ______ CONDITION: ______
TANK: 0 Plastic 0 Metal 0 Other ______	MARKINGS: ______ VOL. OF CONTENTS: ______
OTHER: ______	OTHER: ______

CONTAINER DISPOSITION	CONTENTS DESCRIPTION
SAMPLED: ______ OPENED BUT NOT SAMPLED: Reason ______ NOT OPENED: Reason ______	SINGLE PHASED: ______ MULTIPHASE :

	Layer 1	Layer 2	Layer 3
Phase (Sol. or Liq.)	____	____	____
Color	____	____	____
Viscosity	L, M or H	L, M or H	L, M orH
% of Total Volume	____	____	____

MONITOR READING:	SAMPLE and /or INSPECTION DATE & TIME:
	______ HRS. METHOD: ______
SAMPLER(S) and / or INSPECTOR(S) SIGNATURE:	ANALYSIS:

ATTACHMENT B-5

Tetra Tech NUS, Inc. 661 Andersen Drive Pittsburgh, 15220 (412)921-7090	**Project:** **Site:** **Location:**	
Sample No:		**Matrix:**
Date:	**Time:**	**Preserve:**
Analysis:		
Sampled by:	**Laboratory:**	

ATTACHMENT B-6

TETRA TECH NUS, INC. CHAIN OF CUSTODY | NUMBER | PAGE ____ OF ______

PROJECT NO:	SITE NAME:	PROJECT MANAGER AND PHONE NUMBER	LABORATORY NAME AND CONTACT:
SAMPLERS (SIGNATURE)		FIELD OPERATIONS LEADER AND PHONE NUMBER	ADDRESS
		CARRIER/WAYBILL NUMBER	CITY, STATE

STANDARD TAT ☐
RUSH TAT ☐
☐ 24 hr. ☐ 48 hr. ☐ 72 hr. ☐ 7 day ☐ 14 day

CONTAINER TYPE PLASTIC (P) or GLASS (G)

PRESERVATIVE USED

TYPE OF ANALYSIS

DATE YEAR	TIME	SAMPLE ID	MATRIX	GRAB (G) COMP (C)	No. OF CONTAINERS									COMMENTS

1. RELINQUISHED BY	DATE	TIME	1. RECEIVED BY	DATE	TIME
2. RELINQUISHED BY	DATE	TIME	2. RECEIVED BY	DATE	TIME
3. RELINQUISHED BY	DATE	TIME	3. RECEIVED BY	DATE	TIME

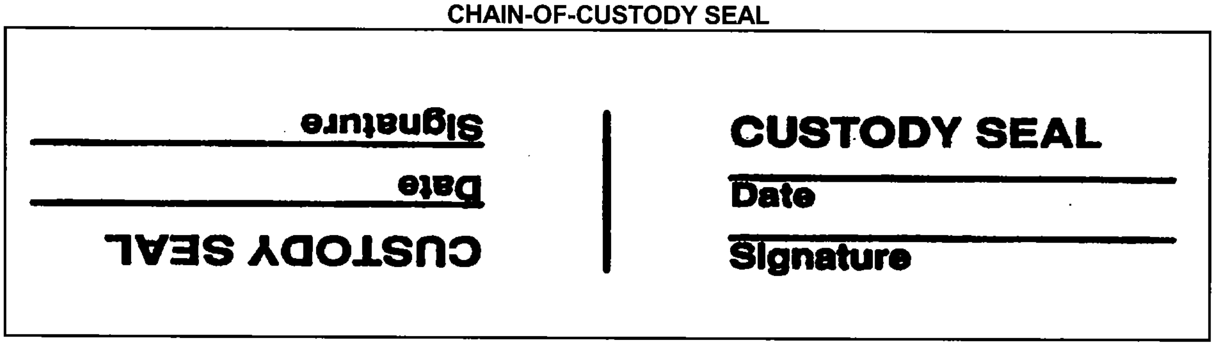
COMMENTS

DISTRIBUTION: WHITE (ACCOMPANIES SAMPLE) YELLOW (FIELD COPY) PINK (FILE COPY)

3/99
FORM NO. TtNUS-001

ATTACHMENT B-7

CHAIN-OF-CUSTODY SEAL



ATTACHMENT B-8

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: ____________ Sample ID No.: ____________

Project No.: ____________ Sample Location: ____________

Sampled By: ____________ Duplicate: ☐

Field Analyst: ____________ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): ____

SAMPLING DATA:

Date: / Time: / Method:	Color (Visual)	pH (S.U.)	S.C. (mS/cm)	Temp. (^{o}C)	Turbidity (NTU)	DO (mg/l)	Salinity (%)	Other

SAMPLE COLLECTION/ANALYSIS INFORMATION:

ORP (Eh) (+/- mv):____________ Electrode Make & Model:____________

Reference Electrode (circle one): Silver-Silver Chloride / Calomel / Hydrogen

Dissolved Oxygen:

Equipment: HACH Digital Titrator OX-DT CHEMetrics (Range: ______mg/L) Analysis Time: ______

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	1-5 mg/L	200 ml	0.200 N	0.01
☐	2-10 mg/L	100 ml	0.200 N	0.02

Titration Count	Multiplier		Concentration
______	x 0.01	=	mg/L
______	x 0.02	=	mg/L

CHEMetrics: ________mg/L

Notes:

Alkalinity:

Equipment: HACH Digital Titrator AL-DT CHEMetrics (Range: ______mg/L) Analysis Time: ______ Filtered: ☐

Range Used:	Range	Sample Vol.	Cartridge	Multiplier	Titration Count	Multiplier		Concentration
☐	10-40 mg/L	100 ml	0.1600 N	0.1	______ & ______	x 0.1	=	mg/L
☐	40-160 mg/L	25 ml	0.1600 N	0.4	______ & ______	x 0.4	=	mg/L
☐	100-400 mg/L	100 ml	1.600 N	1.0	______ & ______	x 1.0	=	mg/L
☐	200-800 mg/L	50 ml	1.600 N	2.0	______ & ______	x 2.0	=	mg/L
☐	500-2000 mg/L	20 ml	1.600 N	5.0	______ & ______	x 5.0	=	mg/L
☐	1000-4000 mg/L	10 ml	1.600 N	10.0	______ & ______	x 10.0	=	mg/L

Parameter:	Hydroxide	Carbonate	Bicarbonate
Relationship:			

CHEMetrics: ________mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:________ Digits Required: 1st.:________ 2nd.:________ 3rd.:________

Carbon Dioxide:

Equipment: HACH Digital Titrator CA-DT CHEMetrics (Range: ______mg/L) Analysis Time: ______

Range Used:	Range	Sample Vol.	Cartridge	Multiplier
☐	10-50 mg/L	200 ml	0.3636 N	0.1
☐	20-100 mg/L	100 ml	0.3636 N	0.2
☐	100-400 mg/L	200 ml	3.636 N	1.0
☐	200-1000 mg/L	100 ml	3.636 N	2.0

Titration Count			Concentration
______	x 0.1	=	mg/L
______	x 0.2	=	mg/L
______	x 1.0	=	mg/L
______	x 2.0	=	mg/L

CHEMetrics: ________mg/L

Notes:

Standard Additions: ☐ Titrant Molarity:________ Digits Required: 1st.:________ 2nd.:________ 3rd.:________

ATTACHMENT B-8 (Continued)

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: ____________ Sample ID No.: ____________

Project No.: ____________ Sample Location: ____________

Sampled By: ____________ Duplicate: ☐

Field Analyst: ____________ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Sulfide (S^{2-}):

Equipment: DR-700 DR-8 _ _ HS-WR Color Wheel Other: ____________ Analysis Time: ____________

Program/Module: 610nm 93

Concentration: ____________ mg/L Filtered: ☐

Notes: ____________

Sulfate (SO_4^{2-}):

Equipment: DR-700 DR-8 _ _ Other: ____________ Analysis Time: ____________

Program/Module: 91

Concentration: ____________ mg/L Filtered: ☐

Standard Solution: ☐ Results: ________

Standard Additions: ☐ Digits Required: 0.1ml:_______ 0.2ml:_______ 0.3ml:_______

Notes: ____________

Nitrite (NO_2^--N):

Analysis Time: ____________

Equipment: DR-700 DR-8 _ _ Other: ____________ Filtered: ☐

Program/Module: 60

Concentration: ____________ mg/L Reagent Blank Correction: ☐

Standard Solution: ☐ Results: ☐

Notes: ____________

Nitrate (NO_3^--N):

Analysis Time: ____________

Equipment: DR-700 DR-8 _ _ Other: ____________ Filtered: ☐

Program/Module: 55

Concentration: ____________ mg/L

Nitrite Interference Treatment: ☐

Standard Solution: ☐ Results: ________ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:_______ 0.2ml:_______ 0.3ml:_______

Notes: ____________

ATTACHMENT B-8 (Continued)

Tetra Tech NUS, Inc.

FIELD ANALYTICAL LOG SHEET
GEOCHEMICAL PARAMETERS

Page __ of __

Project Site Name: ____________ Sample ID No.: ____________

Project No.: ____________ Sample Location: ____________

Sampled By: ____________ Duplicate: ☐

Field Analyst: ____________ Blank: ☐

Field Form Checked as per QA/QC Checklist (initials): ☐

SAMPLE COLLECTION/ANALYSIS INFORMATION:

Manganese (Mn^{2+}):

Equipment: DR-700 DR-8 __ HACH MN-5 Other: ________ Analysis Time: ________

Program/Module: 525nm 41

Concentration: ________ mg/L Filtered: ☐

Digestion: ☐

Standard Solution: ☐ Results: ________ Reagent Blank Correction: ☐

Standard Additions: ☐ Digits Required: 0.1ml:________ 0.2ml:________ 0.3ml:________

Notes: ____________

Ferrous Iron (Fe^{2+}):

Equipment: DR-700 DR-8 __ IR-18C Color Wheel Other: ________ Analysis Time: ________

Program/Module: 500nm 33

Concentration: ________ mg/L Filtered: ☐

Notes: ____________

Hydrogen Sulfide (H_2S):

Equipment: HS-C Other: ________ Analysis Time: ________

Concentration: ________ mg/L Exceeded 5.0 mg/L range on color chart: ☐

Notes: ____________

QA/QC Checklist:

All data fields have been completed as necessary: ☐

Correct measurement units are cited in the SAMPLING DATA block: ☐

Values cited in the SAMPLING DATA block are consistent with the Groundwater Sample Log Sheet: ☐

Mulitplication is correct for each *Multiplier* table: ☐

Final calulated concentration is within the appropriate *Range Used* block: ☐

Alkalinity *Relationship* is determined appropriatly as per manufacturer (HACH) instructions: ☐

QA/QC sample (e.g., Std. Additions, etc.) frequency is appropriate as per the project planning documents: ☐

Nitrite Interference treatment was used for Nitrate test if Nitrite was detected: ☐

Title block on each page of form is initialized by person who performed this QA/QC Checklist: ☐

ATTACHMENT C-1
EXAMPLE GROUNDWATER LEVEL MEASUREMENT SHEET

Tetra Tech NUS, Inc.

GROUNDWATER LEVEL MEASUREMENT SHEET

Project Name: ____________ **Project No.:** ____________

Location: ____________ **Personnel:** ____________

Weather Conditions: ____________ **Measuring Device:** ____________

Tidally Influenced: Yes ___ No ___ **Remarks:** ____________

Well or Piezometer Number	Date	Time	Elevation of Reference Point (feet)*	Total Well Depth (feet)*	Water Level Indicator Reading (feet)*	Thickness of Free Product (feet)*	Groundwater Elevation (feet)*	Comments

* All measurements to the nearest 0.01 foot

Page ___ of ___

ATTACHMENT C-2
EXAMPLE PUMPING TEST DATA SHEET

Tetra Tech NUS, Inc.

PUMPING TEST DATA SHEET

PROJECT NAME: ____________________ PUMPING WELL NUMBER: ____________________
PROJECT NUMBER: ____________________ MEASURED WELL NUMBER: ____________________

[ ] PUMPING TEST [ ] STEP DRAW DOWN TEST

DATE(s): ____________________ MONITORING POINT: ____________________
MEASUREMENT METHOD: ____________________ DEPTH CORRECTION (ft): ____________________
TEST NUMBER: ____________________ PUMP SETTING (Ft. below monitoring point): ____________________
STATIC WATER LEVEL (ft): ____________________ DISTANCE FROM PUMPING WELL (ft): ____________________
PERSONNEL: ____________________
REMARKS: ____________________

MILITARY TIME	ELAPSED TIME SINCE PUMP START OR STOP (Min.)	WATER LEVEL (Ft.)	CORRECTION (Ft.)	DRAW DOWN OR RECOVERY (Ft.)	PUMPING RATE (GPM)	FLOW METER READING (Gals.)	REMARKS

NOTE: All measurements to nearest 0.01 foot measured from top of well riser pipe unless otherwise noted.

ATTACHMENT C-3

PACKER TEST REPORT FORM

PROJECT: ______________________ PROJECT NO.: ______________ TEST NO: ______________ PAGE _____ OF _____
BORING NO.: ______________ CASING DEPTH: __________ CONTRACTOR: ______________________ STATIC WATER LEVEL __________
TEST INTERVAL: ______________ BY: ______________ CHECKED: ______________________ PACKER PRESSURE __________

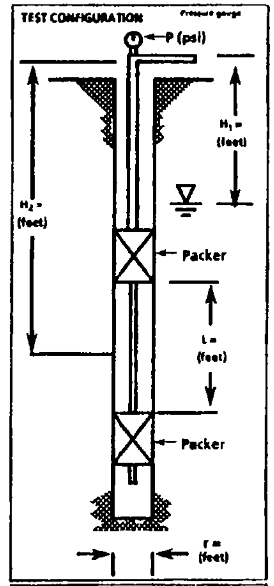
Flow Test					Calculated Results							
Pressure, p (psi)	Elapsed Time (min)	Flow Reading	Δ Flow, ΔQ (ft^3)	Δ Flow, ΔQ (gal)	Flow Rate Q (gal/min)	H_1* (ft)	Hp(Ft) = 2.31·(psi)	H_2* (ft)	H = Hp + (H1 or H2)	Cp	K (ft/yr) = Cp·Q/H	K (cm/sec) = 9.67 x 10^{-7} · K (ft/yr)

CP = (1/(2 π L)) ln(L/r) (70,315 5)
7.48 Gallons = 1 Ft^3
1 psi = 2.31 ft head

* H_1 is used when the test length is below the water table.
H_2 is used when the test length is above the water table.

Remarks: ____

TEST CONFIGURATION



Length of Test Section in feet, l	Cp			
	Drilling Bit Size			
	EX (1.5")	AX (1.875")	BX (2.37")	NX (3")
1	31,000	28,500	25,800	21,300
2	19,400	18,300	16,800	15,500
5	9,800	9,300	8,800	8,200
8	6,800	6,500	6,100	5,850
10	5,700	5,400	5,400	4,940
15	4,100	3,900	3,750	3,600
20	3,200	3,100	3,050	2,880

ATTACHMENT C-3

ATTACHMENT C-4

Tetra Tech NUS, Inc.

BORING LOG

Page ___ of ___

PROJECT NAME: ____________ BORING No.: ____________
PROJECT NUMBER: ____________ DATE: ____________
DRILLING COMPANY: ____________ GEOLOGIST: ____________
DRILLING RIG: ____________ DRILLER: ____________

					MATERIAL DESCRIPTION					PID/FID Reading (ppm)			
Sample No. and Type or RQD	Depth (Ft.) or Run No.	Blows / 6" or RQD (%)	Sample Recovery / Sample Length	Lithology Change (Depth/Ft.) or Screened Interval	Soil Density/ Consistency or Rock Hardness	Color	Material Classification	USCS *	Remarks	Sample	Sampler BZ	Borehole**	Driller BZ**

* When rock coring, enter rock brokeness.

** Include monitor reading in 6 foot intervals @ borehole. Increase reading frequency if elevated reponse read.

Drilling Area Background (ppm): ____

Remarks: ____

Converted to Well: Yes ______ No ______ Well I.D. #: ____________

ATTACHMENT C4 (Continued)

LEGEND
SOIL TERMS

UNIFIED SOIL CLASSIFICATION (USCS)

COARSE-GRAINED SOILS
More Than Half of Material is LARGER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights			GROUP SYMBOL	TYPICAL NAMES
GRAVELS (50%(+)>1/4"ø	CLEAN GRAVELS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	GW	Well graded gravels, gravel-sand mixtures, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines.
	GRAVELS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see ML)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.
SANDS 50%(+)<1/4"ø	CLEAN SANDS (Low % Fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes.	SW	Well graded sand, gravelly sands, little or no fines.
		Predominantly one size or a range of sizes with some intermediate sizes missing.	SP	Poorly graded sands, gravelly sands, little or no fines.
	SANDS W/FINES (High % Fines)	Non-plastic fines (for identification procedures, see MCL)	SM	Silty sands, poorly graded sand-silt mixtures.
		Plastic fines (for identification procedures, see CL)	SC	Clayey sands, poorly graded sand-clay mixtures.

FINE-GRAINED SOILS
More Than Half of Material is SMALLER Than No. 200 Sieve Size

FIELD IDENTIFICATION PROCEDURES (Excluding Particles Larger Than 3 Inches and Basing Fractions on Estimated Weights)				GROUP SYMBOL	TYPICAL NAMES
	Identification Procedures on Fraction Smaller than No. 40 Sieve Size				
	DAY STRENGTH (Crushing Characteristics)	DILATANCY (Reaction to Shaking)	TOUGHNESS (Consistency Near Plastic Limit)		
SILTS AND CLAYS Liquid Limit <50	None to Slight	Quick to Slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.
	Medium to High	None to Very Slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays.
	Slight to Medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.
SILTS AND CLAYS Liquid Limit >50	Slight to Medium	Slow to None	Slight to Medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts.
	High to Very High	None	High	CH	Inorganic clays of high plasticity, fat clays.
	Medium to High	None to Very Slow	Slight to Medium	OH	Organic clays of medium to high plasticity.
HIGHLY ORGANIC SOILS	Readily identified by color, odor, spongy feel and frequently by fibrous texture.			Pt	Peat and other organic soils

Boundary classifications: Soils possessing characteristics of two groups are designated by combining group symbols. For example, GW-GC, well graded gravel-sand mixture with clay binder.
All sieve sizes on this chart are U.S. Standard.

DENSITY OF GRANULAR SOILS	
DESIGNATION	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT
Very Loose	0-4
Loose	5-10
Medium Loose	11-30
Dense	31-50
Very Dense	Over 50

CONSISTENCY OF COHESIVE SOILS			
CONSISTENCY	UNC COMPRESSIVE STRENGTH (TONS/SQ. FT.)	STANDARD PENETRATION RESISTANCE-BLOWS/FOOT	FIELD IDENTIFICATION METHODS
Very Soft	Less than 0.25	0 to 2	Easily pentrated several inches by fist
Soft	0.25 to 0.50	2 to 4	Easily penetrated several inches by thumb.
Medium Stiff	0.50 to 1.0	4 to 8	Can be penetrated several inches by thumb.
Stiff	1.0 to 2.0	8 to 15	Readily indented by thumb.
Very Stiff	2.0 to 4.0	15 to 30	Readily indented by thumbnail.
Hard	More than 4.0	Over 30	Indented with difficulty by thumbnail.

ROCK TERMS

ROCK HARDNESS (FROM CORE SAMPLES)			ROCK BROKENESS		
Descriptive Terms	Screwdriver or Knife Effects	Hammer Effects	Descriptive Terms	Abbreviation	Spacing
Soft	Easily Gouged	Crushes when pressed with hammer	Very Broken	(V. Br.)	0-2"
Medium Soft	Can be Gouged	Breaks (one blow); crumbly edges	Broken	(Br.)	2"-1'
Medium Hard	Can be scratched	Breaks (one blow); sharp edges	Blocky	(Bl.)	1'-3'
Hard	Cannot be scratched	Breaks conchoidally (several blows); sharp edges	Massive	(M.)	3'-10'

LEGEND:

SOIL SAMPLES - TYPES

5-2" Split-Barrel Sample

ST-3" O.D. Undisturbed Sample
O - Other Samples, Specify in Remarks

ROCK SAMPLES - TYPES

X-NX (Conventional) Core (~2-1/8" O.D.)

Q-NQ (Wireline) Core (~1-7/8" O.D.)
Z - Other Core Sizes, Specify in Remarks

12/18

WATER LEVELS

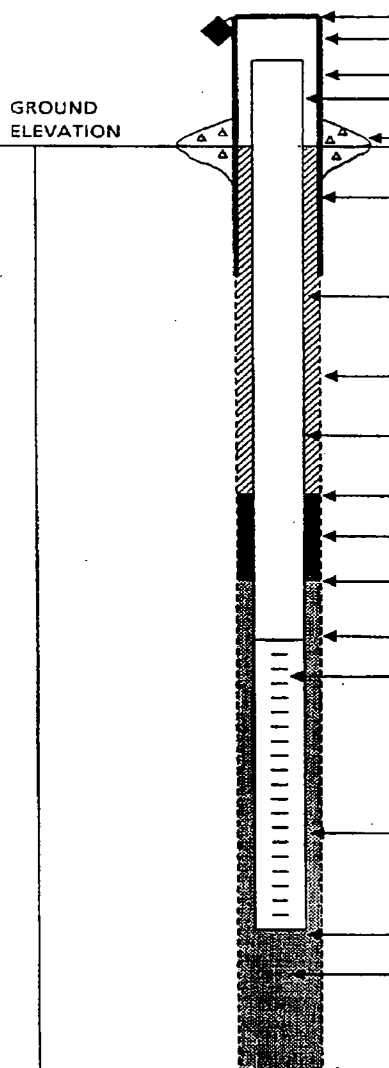
12/18
▽ 12.6' Initial Level w/Date & Depth

ATTACHMENT C-5
EXAMPLE OVERBURDEN MONITORING WELL SHEET

BORING NO.: ____________

OVERBURDEN
MONITORING WELL SHEET

PROJECT ____________ LOCATION ____________ DRILLER ____________
PROJECT NO. ____________ BORING ____________ DRILLING METHOD ____________
ELEVATION ____________ DATE ____________ DEVELOPMENT METHOD ____________
FIELD GEOLOGIST ____________



ELEVATION OF TOP OF SURFACE CASING : ____________
ELEVATION OF TOP OF RISER PIPE: ____________
STICK - UP TOP OF SURFACE CASING: ____________
STICK - UP RISER PIPE : ____________
TYPE OF SURFACE SEAL: ____________
I.D. OF SURFACE CASING: ____________
TYPE OF SURFACE CASING: ____________
RISER PIPE I.D. ____________
TYPE OF RISER PIPE: ____________
BOREHOLE DIAMETER: ____________
TYPE OF BACKFILL: ____________
ELEVATION / DEPTH TOP OF SEAL: ____ / ____
TYPE OF SEAL: ____________
DEPTH TOP OF SAND PACK: ____________
ELEVATION / DEPTH TOP OF SCREEN: ____ / ____
TYPE OF SCREEN: ____________
SLOT SIZE x LENGTH: ____________
I.D. OF SCREEN: ____________
TYPE OF SAND PACK: ____________
ELEVATION / DEPTH BOTTOM OF SCREEN: ____ / ____
ELEVATION / DEPTH BOTTOM OF SAND PACK: ____ / ____
TYPE OF BACKFILL BELOW OBSERVATION WELL: ____________
ELEVATION / DEPTH OF HOLE: ____ / ____

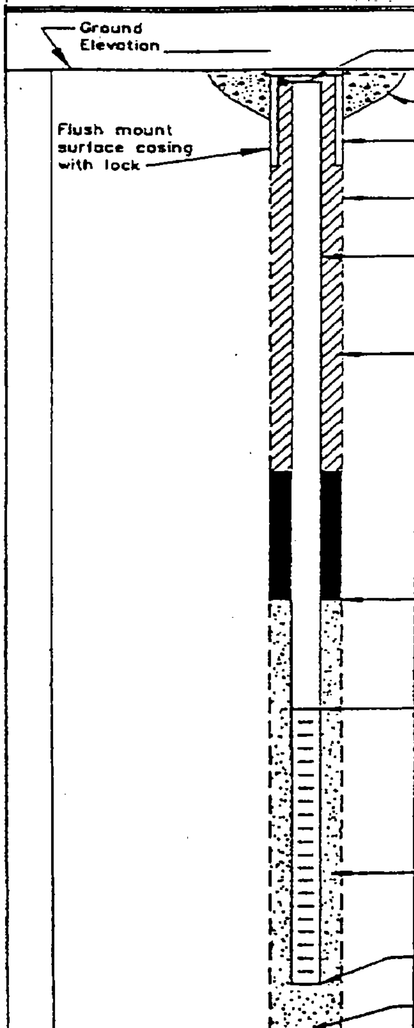
ATTACHMENT C-5A
EXAMPLE OVERBURDEN MONITORING WELL SHEET (FLUSHMOUNT)

BORING NO.: ______

MONITORING WELL SHEET

PROJECT ______ LOCATION ______
PROJECT NO. ______ BORING ______
ELEVATION ______ DATE ______
FIELD GEOLOGIST ______

DRILLER ______
DRILLING METHOD ______
DEVELOPMENT METHOD ______



ELEVATION TOP OF RISER: ______

TYPE OF SURFACE SEAL: ______

TYPE OF PROTECTIVE CASING: ______

I.D. OF PROTECTIVE CASING: ______

DIAMETER OF HOLE: ______

TYPE OF RISER PIPE: ______

RISER PIPE I.D.: ______

TYPE OF BACKFILL/SEAL: ______

______

DEPTH/ELEVATION TOP OF SAND: ____/____

DEPTH/ELEVATION TOP OF SCREEN: ____/____

TYPE OF SCREEN: ______

SLOT SIZE x LENGTH: ______

TYPE OF SAND PACK: ______

DIAMETER OF HOLE IN BEDROCK: ______

DEPTH/ELEVATION BOTTOM OF SCREEN: ____/____

DEPTH/ELEVATION BOTTOM OF SAND: ____/____

DEPTH/ELEVATION BOTTOM OF HOLE: ____/____

BACKFILL MATERIAL BELOW SAND: ______

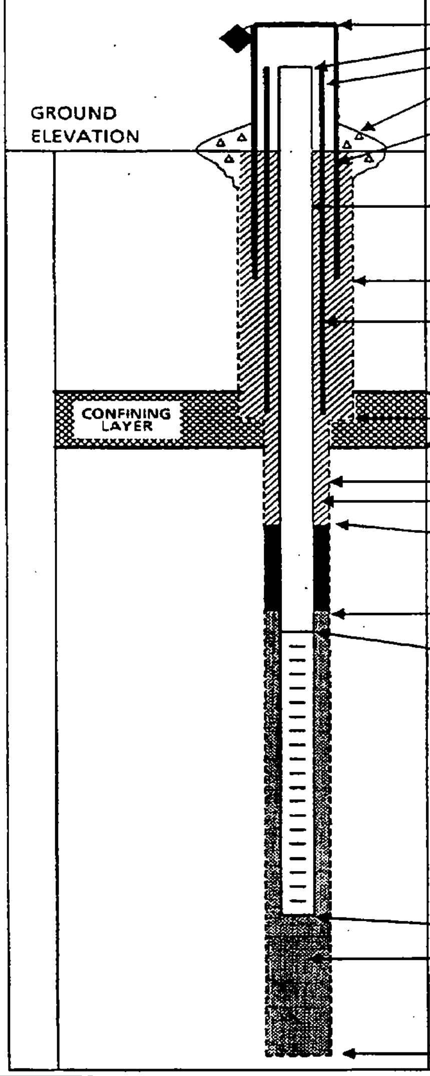
ATTACHMENT C-6
EXAMPLE CONFINING LAYER MONITORING WELL SHEET

BORING NO.: ____________

CONFINING LAYER
MONITORING WELL SHEET

PROJECT ____________ LOCATION ____________
PROJECT NO. ____________ BORING ____________
ELEVATION ____________ DATE ____________
FIELD GEOLOGIST ____________

DRILLER ____________
DRILLING METHOD ____________
DEVELOPMENT METHOD ____________



ELEVATION OF TOP OF SURFACE CASING : ____________
ELEVATION OF TOP OF RISER PIPE: ____________
ELEVATION TOP OF PERM. CASING: ____________
TYPE OF SURFACE SEAL: ____________

I.D. OF SURFACE CASING: ____________
TYPE OF SURFACE CASING: ____________

RISER PIPE I.D. ____________
TYPE OF RISER PIPE: ____________

BOREHOLE DIAMETER: ____________

PERM. CASING I.D. ____________
TYPE OF CASING & BACKFILL: ____________

ELEVATION / DEPTH TOP CONFINING LAYER: ____________
ELEVATION / DEPTH BOTTOM OF CASING: ____________
ELEVATION / DEPTH BOT. CONFINING LAYER: ____________

BOREHOLE DIA. BELOW CASING: ____________
TYPE OF BACKFILL: ____________

ELEVATION / DEPTH TOP OF SEAL: ____________
TYPE OF SEAL: ____________

DEPTH TOP OF SAND PACK: ____________

ELEVATION/DEPTH TOP OF SCREEN: ____________
TYPE OF SCREEN: ____________

TYPE OF SAND PACK: ____________

ELEVATION / DEPTH BOTTOM OF SCREEN: ____________

ELEVATION / DEPTH BOTTOM OF SAND PACK: ____________
TYPE OF BACKFILL BELOW OBSERVATION WELL: ____________

ELEVATION / DEPTH OF HOLE: ____________

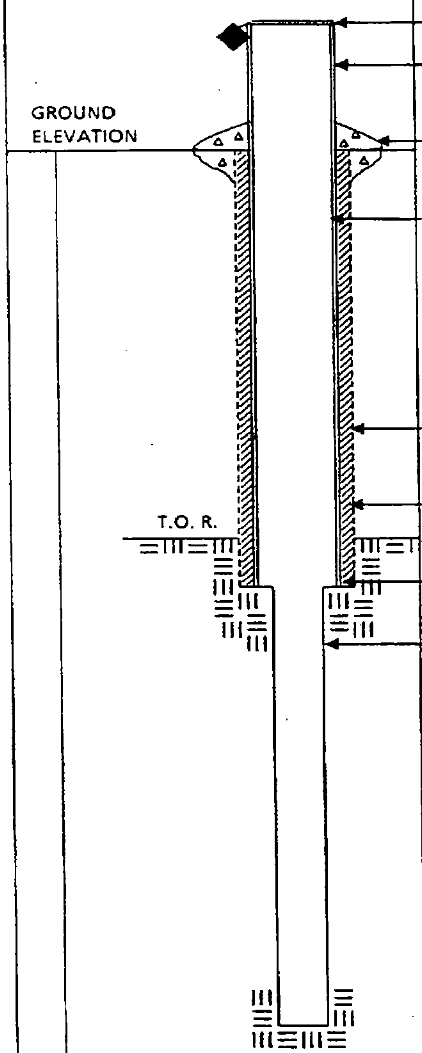
ATTACHMENT C-7
EXAMPLE BEDROCK MONITORING WELL SHEET - OPEN HOLE WELL

BORING NO.: ____________

BEDROCK
MONITORING WELL SHEET
OPEN HOLE WELL

PROJECT ____________ LOCATION ____________
PROJECT NO. ____________ BORING ____________
ELEVATION ____________ DATE ____________
FIELD GEOLOGIST ____________

DRILLER ____________
DRILLING METHOD ____________
DEVELOPMENT METHOD ____________



ELEVATION OF TOP OF CASING: ____________

STICK UP OF CASING ABOVE GROUND SURFACE: ____________

TYPE OF SURFACE SEAL: ____________
____

I.D. OF CASING: ____________
TYPE OF CASING: ____________

TEMP. / PERM.: ____________

DIAMETER OF HOLE: ____________

TYPE OF CASING SEAL: ____________

DEPTH TO TOP OF ROCK: ____________

DEPTH TO BOTTOM CASING: ____________

DIAMETER OF HOLE IN BEDROCK: ____________

DESCRIBE IF CORE / REAMED WITH BIT:
____
____
____

DESCRIBE JOINTS IN BEDROCK AND DEPTH:
____
____
____

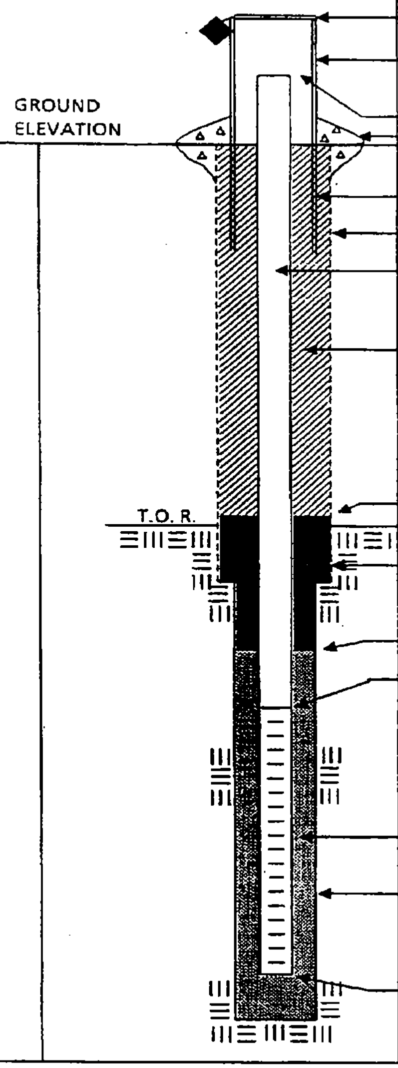
ELEVATION / DEPTH OF HOLE: ______/______

ATTACHMENT C-8
EXAMPLE BEDROCK MONITORING WELL SHEET - WELL INSTALLED IN BEDROCK

BORING NO.: __________

BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT __________ LOCATION __________ DRILLER __________
PROJECT NO. __________ BORING __________ DRILLING METHOD __________
ELEVATION __________ DATE __________ DEVELOPMENT METHOD __________
FIELD GEOLOGIST __________



ELEVATION OF TOP OF SURFACE CASING: __________
STICK UP OF CASING ABOVE GROUND SURFACE: __________
ELEVATION TOP OF RISER: __________
TYPE OF SURFACE SEAL: __________
I.D. OF SURFACE CASING: __________
DIAMETER OF HOLE: __________
RISER PIPE I.D.: __________
TYPE OF RISER PIPE: __________
TYPE OF BACKFILL: __________
ELEVATION / DEPTH TOP OF SEAL: ____ / ____
ELEVATION / DEPTH TOP OF BEDROCK: ____ / ____
TYPE OF SEAL: __________
ELEVATION / DEPTH TOP OF SAND: ____ / ____
ELEVATION / DEPTH TOP OF SCREEN: ____ / ____
TYPE OF SCREEN: __________
SLOT SIZE x LENGTH: __________
I.D. SCREEN: __________
TYPE OF SAND PACK: __________
DIAMETER OF HOLE IN BEDROCK:
CORE / REAM: __________
ELEVATION / DEPTH BOTTOM SCREEN: ____ / ____
ELEVATION / DEPTH BOTTOM OF HOLE: ____ / ____

ATTACHMENT C-9
EXAMPLE BEDROCK MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK (FLUSHMOUNT)

BORING NO.: ________

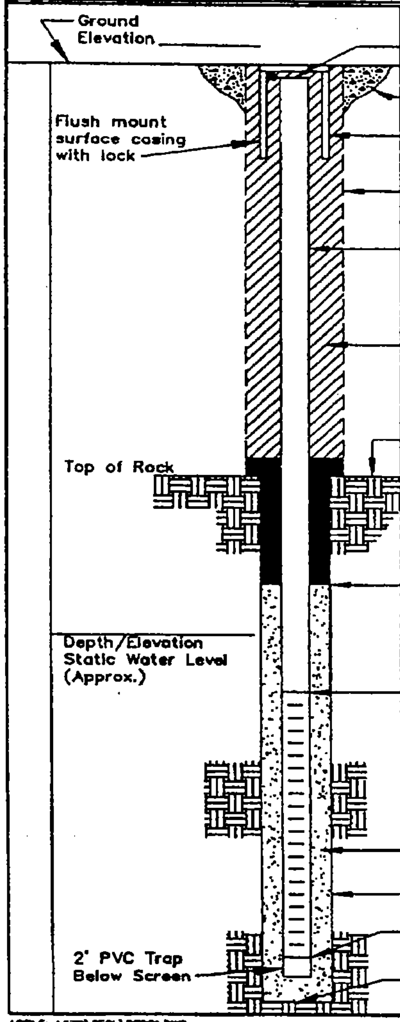
BEDROCK
MONITORING WELL SHEET
WELL INSTALLED IN BEDROCK

PROJECT: ________ LOCATION: ________ DRILLER: ________

PROJECT NO.: ________ BORING: ________ DRILLING METHOD: ________

ELEVATION: ________ DATE: ________ DEVELOPMENT METHOD: ________

FIELD GEOLOGIST: ________



ELEVATION TOP OF RISER: ________

TYPE OF SURFACE SEAL: ________

TYPE OF PROTECTIVE CASING: ________

I.D. OF PROTECTIVE CASING: ________

DIAMETER OF HOLE: ________

TYPE OF RISER PIPE: ________

RISER PIPE I.D.: ________

TYPE OF BACKFILL/SEAL: ________

DEPTH/ELEVATION TOP OF BEDROCK: ____/____

DEPTH/ELEVATION TOP OF SAND: ____/____

DEPTH/ELEVATION TOP OF SCREEN: ____/____

TYPE OF SCREEN: ________

SLOT SIZE x LENGTH: ________

TYPE OF SAND PACK: ________

DIAMETER OF HOLE IN BEDROCK: ________

DEPTH/ELEVATION BOTTOM OF SCREEN: ____/____

DEPTH/ELEVATION BOTTOM OF SAND: ____/____

DEPTH/ELEVATION BOTTOM OF HOLE: ____/____

BACKFILL MATERIAL BELOW SAND: ________

ATTACHMENT C-10
EXAMPLE TEST PIT LOG

TEST PIT LOG

Tetra Tech NUS, Inc.

PROJECT: ______________________ TEST PIT NO.:
PROJECT NO ______________ DATE: ____________
LOCATION: ______________________
FIELD GEOLOGIST: ______________________

DEPTH (Ft.)	LITHOLOGY CHANGE (Depth/Ft.)	MATERIAL DESCRIPTION (Soil Density / Consistency, Color)	USCS	REMARKS

Test Pit Cross Section and / or Plan View

REMARKS ______________________

PHOTO LOG ______________________

TEST PIT ________

PAGE ____ OF ____

ATTACHMENT C-11
EXAMPLE CERTIFICATE OF CONFORMANCE

MONITORING WELL MATERIALS CERTIFICATE OF CONFORMANCE

Well Designation: ______________________ Site Geologist: ______________________
Site Name: ______________________ Drilling Company: ______________________
Date Installed: ______________________ Driller: ______________________
Project Name: ______________________ Project Number: ______________________

Material	Brand/Description	Source/Supplier	Sample Collected ?
Well Casing			
Well Screen			
End Cap			
Drilling Fluid			
Drilling Fluid Additives			
Backfill Material			
Annular Filter Pack			
Bentonite Seal			
Annular Grout			
Surface Cement			
Protective Casing			
Paint			
Rod Lubricant			
Compressor Oil			

To the best of my knowledge, I certify that the above described materials were used during installation of this monitoring well.

Signature of Site Geologist: ______________________

ATTACHMENT C-12
EXAMPLE MONITORING WELL DEVELOPMENT RECORD

Tetra Tech NUS, Inc.

MONITORING WELL DEVELOPMENT RECORD

Page ___ of ____

Site: ______________ Depth to Bottom (ft.): ______________ Project Name: ______________
Well: ______________ Static Water Level Before (ft.): ______________ Project Number: ______________
Date Installed: ______________ Static Water Level After (ft.): ______________ Site Geologist: ______________
Date Developed: ______________ Screen Length (ft.): ______________ Drilling Co.: ______________
Dev. Method: ______________ Specific Capacity: ______________
Pump Type: ______________ Casing ID (in.): ______________

Time	Estimated Sediment Thickness (Ft.)	Cumulative Water Volume (Gal.)	Water Level Readings (Ft. below TOC)	Temperature (Degrees C)	pH	Specific Conductance (Units _____)	Turbidity (NTU)	Remarks (odor, color, etc.)

ATTACHMENT D
EXAMPLE EQUIPMENT CALIBRATION LOG

Tetra Tech NUS, Inc.

EQUIPMENT CALIBRATION LOG

PROJECT NAME : ____________

SITE NAME: ____________

PROJECT No.: ____________

INSTRUMENT NAME/MODEL: ____________

MANUFACTURER: ____________

SERIAL NUMBER: ____________

Date of Calibration	Instrument I.D. Number	Person Performing Calibration	Instrument Settings		Instrument Readings		Calibration Standard (Lot No.)	Remarks and Comments
			Pre-calibration	Post-calibration	Pre-calibration	Post-calibration		

ATTACHMENT E

Tetra Tech NUS, Inc.

DAILY ACTIVITIES RECORD

PROJECT NAME: ____________________ **PROJECT NUMBER:** __________

CLIENT: ____________________ **LOCATION:** __________

DATE: ____________________ **ARRIVAL TIME:** __________

Tt NUS PERSONNEL: ____________________ **DEPARTURE TIME:** __________

CONTRACTOR: ____________________ **DRILLER:** __________

ITEM	QUANTITY ESTIMATE	QUANTITY TODAY	PREVIOUS TOTAL QUANTITY	CUMULATIVE QUANTITY TO DATE

COMMENTS: ____________________

APPROVED BY:

Tt NUS REPRESENTATIVE

DRILLER

DATE: __________

ATTACHMENT F
FIELD TRIP SUMMARY REPORT
PAGE 1 OF 2

SUNDAY

Date: ______________________ Personnel: ______________________

Weather: ______________________ Onsite: ______________________

Site Activities: ____

____

____

____

MONDAY

Date: ______________________ Personnel: ______________________

Weather: ______________________ Onsite: ______________________

Site Activities: ____

____

____

____

TUESDAY

Date: ______________________ Personnel: ______________________

Weather: ______________________ Onsite: ______________________

Site Activities: ____

____

____

____

WEDNESDAY

Date: ______________________ Personnel: ______________________

Weather: ______________________ Onsite: ______________________

Site Activities: ____

____

____

____

ATTACHMENT F
PAGE 2 OF 2
FIELD TRIP SUMMARY REPORT

THURSDAY

Date: ______________________ Personnel: ______________

Weather: ______________________ Onsite: ______________

Site Activities: ______________________________________

____

____

____

FRIDAY

Date: ______________________ Personnel: ______________

Weather: ______________________ Onsite: ______________

Site Activities: ______________________________________

____

____

____

SATURDAY

Date: ______________________ Personnel: ______________

Weather: ______________________ Onsite: ______________

Site Activities: ______________________________________

____

____

____